COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC.

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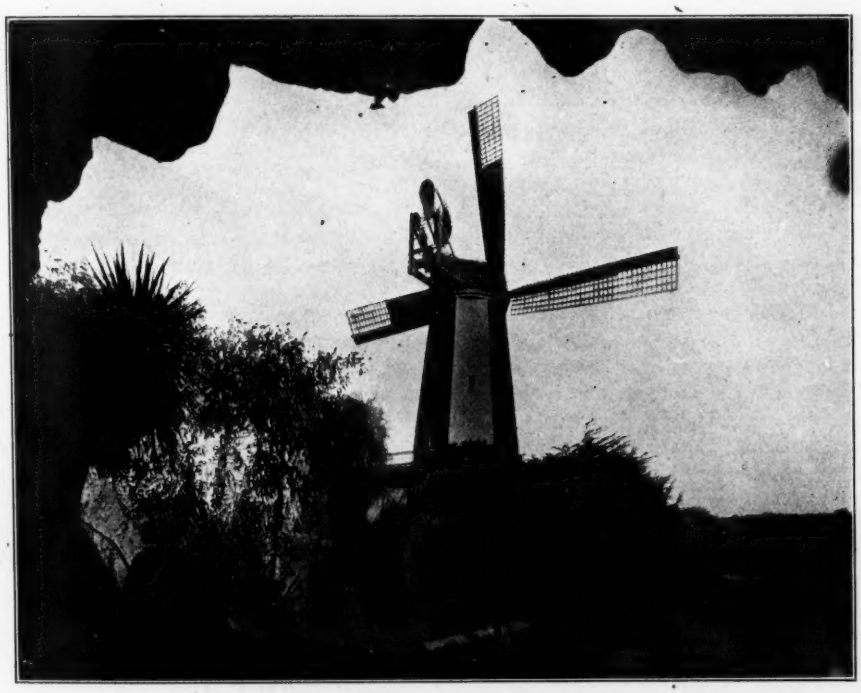
THE LARGEST WINDMILL IN THE UNITED STATES

Several years ago a Dutch windmill was built in Golden Gate Park, San Francisco, close to the tossing waves of the Pacific. So picturesque was its appearance and so successful



BIGGEST WINDMILL IN THE UNITED STATES.

its operation that its mate has been recently constructed several hundred feet to the south. These are the two largest windmills in the United States, the original having a diameter of 102 feet and the new of 114. The sweeping arms of these transplanted scions of Holland greet the mariner entering the harbor of San Francisco from the Pacific. They pump water for the various artificial lakes in which this great park abounds.

The powers of Nature are valuable in proportion to their economy and their dependability. There is probably nothing cheaper than wind, and nothing as unreliable. But in this case the trade winds from the Pacific spring up about the time the dry season begins and blow a steady gale until the fall rains set in; their gentle insistence drives this great mill

and pumps much of the water required during this period of natural drougth. With their utility and dependability proven by use, they combine the rare quality of being both useful and ornamental.

The new mill stands 85 feet from the ground to the centre support of the arms, these having a further radius of 57 feet, which gives a total height of 142 feet. Their tower support is essentially a truncated, octagonal pyramid, substantially built and covered with slate. The base is constructed of concrete strongly reinforced with steel rails. The basal diameter is 60 feet, gradually diminishing to 24 feet at the turret top. Within this five storied tower, whose walls taper from a thickness of four feet at the base, is placed a great pump, having a capacity of 60,000 gallons hourly. Each story of the structure provides a support for the vertical shaft which transmits the power from the windmill to the pump.

The four arms, or sails, of the mill turn a great steel shaft, twenty-two feet long and thirteen inches in diameter to which they are attached by a heavy iron hub. Each of these arms consists of a long spar of Oregon pine, upon which are mounted wind-boards and sails to give an effective wind area of 516 square feet for each arm, making a total of 2064. This maximum may be considerably reduced by furling the canvas in case of high winds. A small steering wheel with a diameter of sixteen feet keeps the power wheel always in the wind, just as the helmsman controls a ship by the rudder. The steering wheel stands at right angles to the large mill so that its blades receive no energy as long as the large mill is directly to the wind. Should the wind direction shift ever so slightly, the small wheel turns and pulls the power mill into the wind again, its motion being transmitted through four sets of gears to the revolving turret, giving a ratio of 7,500 to 1. A double band brake, lever-operated, has been substituted for the half brake of similar type, which proved insufficient to hold the mill if it was to be stopped.

Experience in Holland has shown that a maximum of power is obtained with a slight elevation of the axis above the horizontal, and consequently the main shaft has been mounted at an angle of twelve degrees, thirty minutes. The power varies of course with the velocity of the wind and the extent of sail area exposed. The following table has been compiled for various wind velocities at a maximum sail area:

Miles per hour.	Horse power.
4	0.383
6	1.283
8	2.193
10	5.953
11	7.473
12	10.32
14	16.35
16	24.37
18	34.65
20	47.63
25	92.91
30	160.75
40	381.08

These results are theoretical. The sails are furled as the wind velocities exceed 20 miles per hour. The view is taken looking out of a tunnel which is one of the scenic features of the park.—*Journal of Electricity, Power and Gas,* San Francisco.

A NEW SUB-AQUEOUS ROCK-BREAKING MACHINE WITH HAMMER ACTING IN COMPRESSD AIR

It being understood from the title that compressed air is an essential agent in the operation of this apparatus, a first glance at the sketch, Fig. 1, may suggest that here is simply an enormous pneumatic hammer, similar in principle of operation to the familiar portable hand manipulated pneumatic hammer. The function of compressed air in this case, however, is entirely different. Compressed air does not operate the hammer, but merely displaces the water in the vertical tube of caisson in which the hammer travels, so that it may have a free drop upon the chisel, instead of losing its force by dropping through the water, as has been the practice previously.

The cuts herewith we reproduce from *Engineering News,* and the description following is an abstract of an article contributed to that journal by Barton H. Coffey, M. E., 71 Wall St., New York.

This rock breaker, entirely of American origin and development, and embodying many novel and interesting features, has lately removed some ledges in the 35 ft. ship channel in Boston harbor; a harbor badly obstructed by reefs, which it is impossible to avoid in

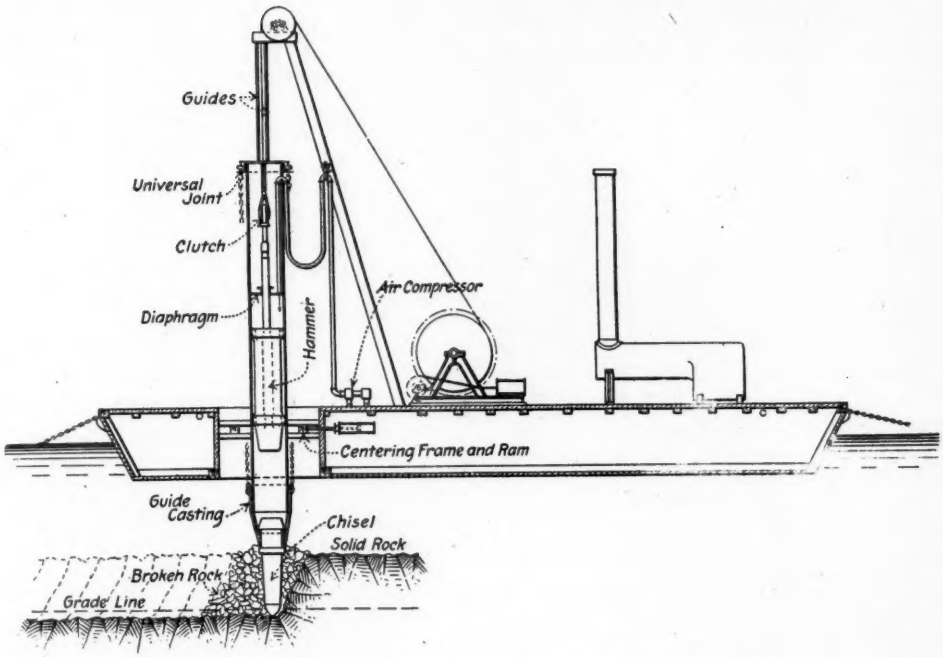


FIG. I.—SUA-AQUEOUS ROCK CHISEL WORKING IN COMPRESSRD AIR.

any comprehensive scheme of improvement. The ledges consist of metamorphic slate, varying from markedly stratified rock to that almost igneous, the stratification inclining upstream and lying about 15 degrees from the vertical. It is all hard, and some of it exceedingly so.

Practically all of the work here has been done heretofore by drilling and blasting, but the high cost and slow progress led to attempts to break the rock with chisel machines. Chisels of the exposed drop type were tried on certain contracts at 27 ft. mean low water, but they failed utterly.

To the ordinary exposed drop chisel, shown diagrammatically in Fig 2, which is lifted and drops through the water upon the rock, there are three objections:

First, the water resistance is serious. It increases as the cube of the velocity, checks the fall of the chisel and deadens the blow.

Second, at each blow the chisel must penetrate the rock already broken, resulting in the useless expenditure of a portion of its energy in breaking the broken rock still finer. The efficiency of the machine falls off so rapidly that it is found to be impracticable to break up the rock in layers over 3 ft. thick.

Third, as it has not been found feasible to guide the falling chisel, the successive blows are not delivered on the same spot, but are scattered over a considerable area, thus losing the enormous cumulative advantage in splitting the rock produced by the following-up effect when the blows are concentrated on a fixed point.

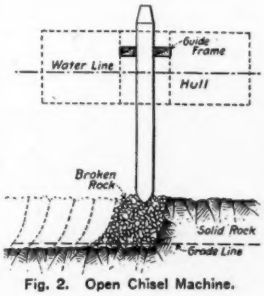


Fig. 2. Open Chisel Machine.

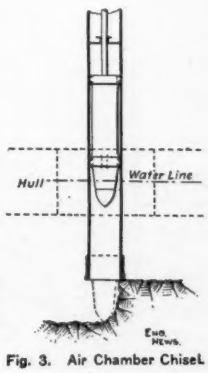


Fig. 3. Air Chamber Chisel.

These defects are overcome by the new machine shown in outline in Fig. 1. It will be understood that the framing here shown is in-

complete. The chisel is made short and light, and it rests permanently upon the rock when in operation. The upper portion of the chisel is embraced by a guide casting, in which it slides freely with a limited vertical movement, a shoulder on the chisel supporting the guide, and the chisel head preventing the chisel from dropping when the guide is lifted. The guide is a sliding fit upon the end of the tube, which it supports upon an interior shoulder. The upper end of the tube is fitted with a universal joint, provided with shoes adopted to slide in the vertical guides. The tube extends through a well in the hull of the barge, the dimensions of the well being considerably larger than the tube, to permit local movement of the latter. The entire weight of the assembage is thus concentrated upon the chisel point resting on the rock, and it still is free to move both vertically and laterally.

The tube or caisson is divided into two compartments by a diaphragm, the upper compartment being open to the atmosphere, while the lower compartment or working chamber is kept free from water by the compressed air which enters by the pipe connected to the diaphragm, fills the compartment and escapes through openings in the bottom of the guide.

The heavy hammer is lifted and dropped upon the head of the chisel, driving it into the rock. The tube is the only guide for the hammer, which is provided with ample openings in its bearing rings to allow free passage of the air up or down as the hammer reciprocates. The hammer is lifted by a rod which passes through the stuffing box in the diaphragm. This rod is provided with a barbed end, which is seized by a clutch attached to the hoisting tackle. At any desired point the clutch is tripped, dropping the hammer upon the chisel. The upper chamber of the tube is provided with guides for the clutch. The only retarding influences over a free drop in the open air are the friction against the walls of the tube, friction of the air passing through the openings in the hammer, friction of the stuffing box and the unbalanced air pressure upon the area of the lifting rod; the sum total of those in percentages of the kinetic energy of the hammer is negligible, and it may be said that the hammer develops at impact practically the full theoretical effect at any drop. The best evidence of this is in the fact that the exposed drop chisels are generally operated at 8 ft. drop, whereas 3 ft. is ample with the pneumatic chisels.

After a penetration is completed the releasing gear is not allowed to trip the clutch, and then the hoisting first lifts the hammer up to touch the diaphragm, and further hoisting raises the tube and all together, and the machine can then be moved to the next spot.

On beginning a penetration, the tube is lowered through a sliding frame which centers it with the guides, thus insuring accurate spacing of penetrations. As soon as the chisel reaches the rock the frame is withdrawn, permitting lateral motion while the breaking is in progress. As the chisel point follows the line of cleavage, and as this is rarely vertical, there is a gradual horizontal displacement of the chisel point while the penetration is in progress. In Fig. 3 a chisel point is shown attached to the hammer, the guides and chisel at the bottom then being dispensed with.

The machine working in Boston harbor in depths of 47 feet has made penetrations of six and seven feet without difficulty, thus doubling the volume of rock broken at a single passage of the machine as compared with the work of the exposed drop chisel. The efficiency of this machine is quite independent of the depth, as proved by the work on the 35 ft. channel at Boston. As this depth is at mean low water and as the tides at Boston rise from 9 to 12 ft., the work must be done to maximum depths of 47 ft.

The general dimensions of the machine as used are as follows:

Hull, 32 ft. x 90 ft. x 12 ft. deep; frame, 65 ft. high. The hammer is a single steel casting, weighing about 12 tons, and does its work with a drop of about 3 ft., 140 drops per hour. The vertical caisson is of welded steel, weighing with its attached parts about 12 tons. The air compressor is 12 in. dia. by 9 in. stroke, double acting, the working air pressure varying with the submergence and being about 1 lb. for each two feet of depth under water. Large volumes of air are used, this all escaping at the bottom of the tube or caisson, inducing water currents which sweep away loose material overlying the ledge. It is not necessary to say anything here about the means for precisely locating and securely holding the float.

The machine has been operated in New York harbor at 22 ft. low water in the micaceous schists of that vicinity, and is now engaged on

a contract on the Penobscot River, Maine, amounting to about 9,000 cu. yds. of shallow cutting in metamorphic slate. The patent rights on the apparatus are controlled by the Submarine Company, 71 Wall St., New York.

The Roosevelt dam now being built by the United States Reclamation Service, on Salt River, Ariz., when completed, will be far the largest artificial lake in the world. It will impound 1,300,000 acre-feet of water, or 423,577,440,000 gallons. At present an Indian reservoir, which is filled only once in about 20 years, is the largest, with a capacity of 950,000 acre-feet.

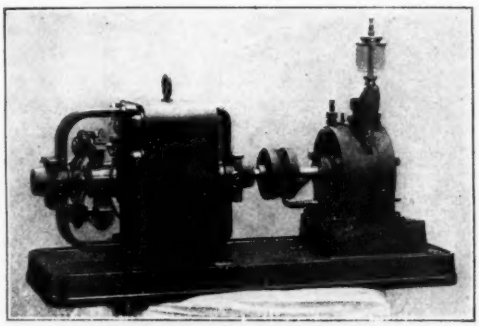


FIG. I.—ROTARY COMPRESSOR.

GERMAN ELECTRIC DRIVEN PUMPS AND COMPRESSORS

By FRANK C. PERKINS.

For driving rotary pumps or compressors the electric motor is especially desirable, as current can be obtained without great expense, and the apparatus gives good efficiency. Fig. 1 shows a German air compressor directly coupled to a continuous current bipolar motor, and supplying air at from 1.2 to 2 atmospheres, and Fig. 2 shows a four pole direct current motor driving a vacuum pump which reaches an absolute pressure of 1.5 mm. (.059 in.) of mercury column.

The electric motor is very satisfactory as a source of power for portable work as it can be mounted on a truck and moved to any place where the machine which it drives is needed. Fig. 3 shows a portable motor and air compressor, the receiver being placed underneath the car, and the necessary switch, cut-outs and gage at the side, the reel carrying sufficient cable with electric connections for tapping a light or power circuit wherever convenient.

EDISON ON EDUCATION AND ACHIEVEMENT

Mr. T. A. Edison seems to be learning to talk, and when he talks he has something to say. In a recently reported interview he gives his views on education as preparatory to engineering occupations, and his estimate of the value of a college education is not high.

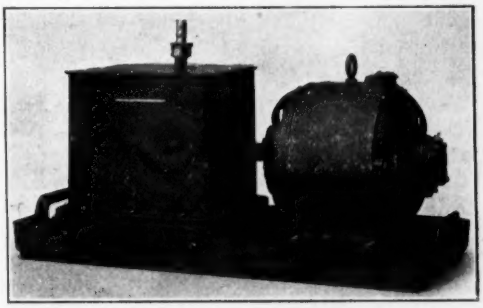


FIG. II.—ELECTRICALLY OPERATED VACUUM PUMP.

In scientific work, as in all other work, he says, the chief factor of success is the power of sticking to a thing. I attribute all that I have accomplished to the fact that I hold on where most persons get discouraged. Another fundamental characteristic for a successful scientist is the power of being a close observer. For instance, while I am experimenting to find some special thing by my close observation I often see dozens of other things not connected with what I am after, and thus the scientific field is one that is constantly expanding and broadening out into new fields.

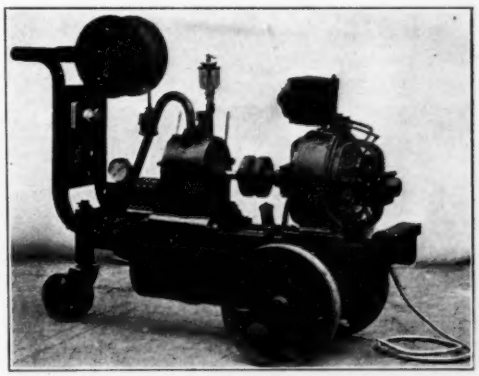


FIG. III.—PORTABLE COMPRESSOR.

"Unlimited opportunities are offered in the scientific field for good practical scientists, and the higher positions are awaiting the skilled

men. For all the $3,000 or $4,000 positions there are many capable candidates, but when it comes to the $10,000, $15,000 or $20,000 positions it is very hard to find the right man. Accordingly at the present time many important high salaried positions are vacant for want of enough capable scientists. In fact the modern times are always demanding a higher intellectual standard for all important positions.

"What the country needs now is the practical, skilled engineer who is capable of doing anything. In three or four hundred years, when the country is settled and commercialism is diminished, there will be time for the literary men. At present we want engineers, industrial men, good business managers and railroad men. In fact there is a field for fine men everywhere.

"One of the chief attractions of scientific work is that it is extremely and constantly interesting. A literary career often becomes monotonous, while scientific work is always increasing in interest. This spirit is shown, for example, by a machinist who toils at one thing all the time, but just set him at some experiment for a while and his keen interest in the work is at once manifest.

"My greatest objection to a college education for a scientist is that academic or classic learning is old and does not keep progress with the times. It does not teach a man to think practically. Science is deeper than Latin or Greek. It is easy for a lawyer to get along with small ability, but a poor engineer is found out in less than six weeks and unless he has learned to think for himself and understands his work he cannot succeed.

"A scientific education is valuable not alone to an engineer but also to a business man, for it teaches practical lessons. On the other hand. Latin and Greek are of no value to the practical business or industrial man. If colleges could teach their men to become first class draughtsmen that would be a great advance, for skilful draughting implies that a man can do anything. In my opinion the best course offered at present in the colleges is economics, for this strengthens the mind in many ways and gives one a clear conception of things as they really are.

"In conclusion I say that as it is impossible to learn everything in the world let each man pick his course, and with care then follow it out. As for the literary or professional man, although this is not the time for the former, he should follow a classical course such as is offered at Yale, Harvard, Princeton or some of the other colleges."

THE NEW BERGEN TUNNEL OF THE LACKAWANNA R. R.

The Delaware, Lackawanna & Western Railroad has just opened to traffic its new two-track tunnel through Jersey City Heights. The old tunnel will now be used exclusively for outbound trains and the new one for incoming trains. The new tunnel is about seven-eighths of a mile long, and the work presented no unusual difficulties beyond the hardness of the solid trap rock. Work was begun in March, 1906, with electric drills (not electric air) and a year later the contract was annulled by mutual consent and the railway company assumed the work. The first thing done was to change the drills from electric to compressed air, a compressing plant being installed near the western portal.

There are two vertical openings 85x100 ft., extending 80 ft. to the surface, and walled with 18 in. of concrete. There are also two ventilators, and these with the larger openings keep the tunnel practically clear of smoke and gas. The entire base is lined with concrete a foot thick, and drain pipes are placed at regular distances embedded in the concrete to allow the water from the rock to flow away without damage to the masonry. Pipes to carry wires have been embedded beneath the tracks, and bolts in the ceiling anticipate the future when electricity may be adopted for motive power.

INDICATOR CARDS FROM VARIABLE VOLUME AIR COMPRESSOR

In our issue for September, 1908, page 5003, we presented illustrations and description of a large Canadian variable volume air compressor installed at a British Columbia copper mine. The indicator cards on the opposite page are from that compressor, taken as running on its regular daily work. They were sent to the *American Machinist*, from whose pages we reproduce them without change of scale, by Mr. H. V. Haight, chief engineer of the Canadian Rand Drill Company, the designer of the compressor. We are thus relieved of all responsibility as to the cards, which cannot fail to in-

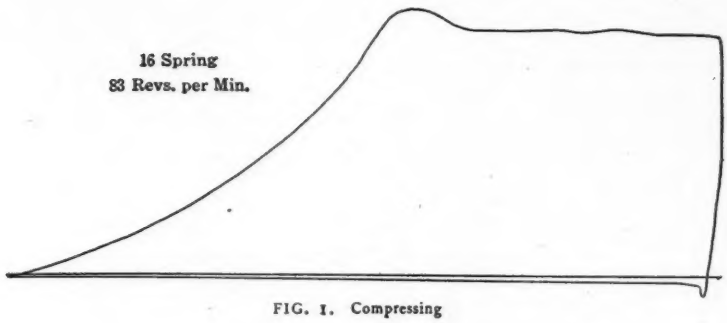


FIG. 1. Compressing

Left Crank, 16 Spring, 83 Revs. per Min.

FIG. 2. Unloaded

LOW-PRESSURE CYLINDER CARDS

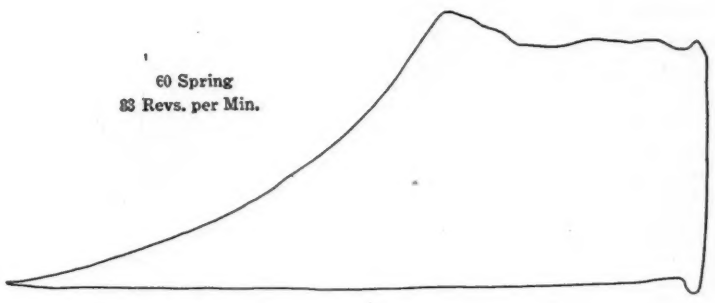


FIG. 3. Compressing

Left H.P. Crank - 60 Spring

FIG. 4. All Unloaded

HIGH-PRESSURE CYLINDER CARDS

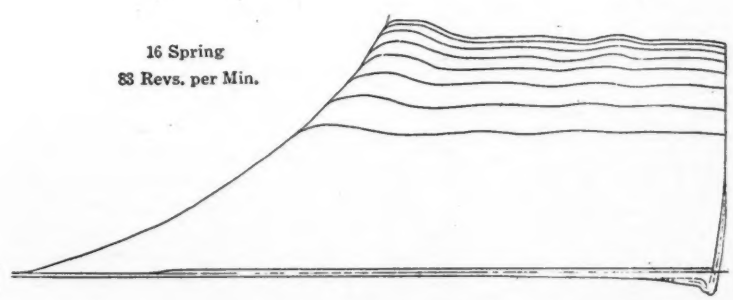


FIG. 5. LOW-PRESSURE CYLINDER PICKING UP LOAD

terest those who have to do with large air compression problems.

It will be recalled, Mr. Haight says, that the machine shown was a 25x16x36 in. duplex-tandem air compressor, having a capacity of about 3400 cubic feet, and driven by a 600 horse-power motor by means of a rope drive. The special feature of the machine is the unloading device by which one-quarter of the load is thrown off at a time, by holding open one high-pressure Corliss inlet valve and one low-pressure Corliss inlet valve at each step. In reality the low-pressure Corliss valve is held open slightly before its corresponding high-pressure valve. This makes the unloading and the taking up of the load again come in practically eight steps and allows a little drop in the intercooler pressure between the four regular steps. This is well shown in Fig. 5 where the low-pressure cylinder is taking up its load.

It is hardly necessary to point out that these cards show almost perfect valve action both when compressing and when running unloaded. Further evidence of the very complete unloading of the machine is shown by the fact that the starting current, required for the alternating motor which runs the machine, does not exceed the full-load current. The completeness of the unloading as well as the very small friction of the motor, rope drive and compressor is also shown by the fact that the machine will run six minutes after the current is cut off.

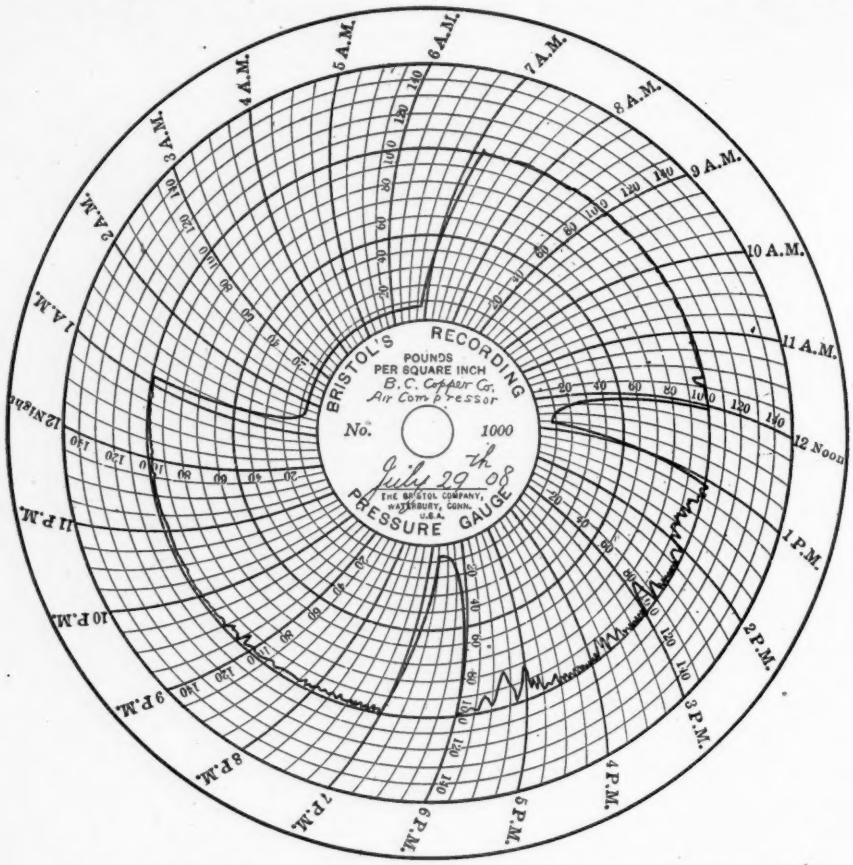


FIG. 6. PRESSURE-GAGE RECORD FOR VARIABLE-VOLUME AIR COMPRESSOR

The action of the unloader in maintaining steady air pressure is shown by the recording-gage diagram, Fig. 6. It will be seen that the machine is shut down from noon to 1 p. m., from 6 to 7 p. m. and also from 1 a. m. to 7 a. m. From 1 p. m. to 6 p. m. the machine is often overloaded, probably on account of opening up an air pipe to blow away the smoke from blast-

ing. Except when overloaded or shut down the pressure is maintained at 97 to 100 pounds; the maximum variation does not exceed three pounds.

CARNEGIE AND THE CHEMIST

When Andrew Carnegie was young in the steel business, a short time after the starting of his first plant in Pittsburg, he had an experience with iron ore which he never forgot. This is how he tells it:

I was offered some ore that sampled about the usual grade, so far as I was able to judge from appearances, and at a reduced price. I bought several thousand tons, a big order for those days. The second day after we commenced to run it the foreman came to the office and told me the new ore was of no account, that it did not flow and that the furnaces were so choked they would have to be dumped very soon, unless some remedy was found. Those fires were built to last two years and to dump them at this time would mean so heavy a loss as to practically put me out of business. A young chemist had called on me a few weeks before, and while I had not paid much attention to him I had kept his card. It occurred to me that he might possibly be of some help, though I confess I did not then see what chemistry had to do with the iron business. But I sent for him and he came at once. First he examined the new ore, then the old, that we had been running without difficulty, and finally he looked at the furnaces. To avoid delay he made a little test of the two ores right there. I had told him when he arrived that I felt sure the new ore was worthless and admitted my mistake in buying it. Of course I did this as I did not want him to think I was ignorant of the business. You can imagine my surprise, then, when at the conclusion of his test, he quietly informed us that the new ore was so good, we did not know how to run it. The fact was that the new ore contained twenty per cent. more iron than the old, and all that it was necessary to do was to add a proportionate increase of flux to bring about reduction.

"After this great help, I kept that chemist in mind and it was not long after the experience just mentioned that his scientific training proved of such practical help to me that I have no hesitation in declaring it was a chemist who gave me my first real start in the iron business. I was in the habit of going home from work by a path that led along the river's edge and past a big rolling mill. On the evening to which I refer I noticed a number of men coming out of the mill yard with wheelbarrow loads of black material that seemed to be in flakes. They were emptying this along the river bank and from the condition of the place it would seem that hundreds of tons of it had been thrown there. Curiosity prompted me to ask one of the men what the material might be. He told me that it was the scale that peeled off iron when it was rolled or beaten. Wanting to know something more concerning it, I pocketed a handful and, without any word of explanation sent it next day to my chemist for analysis. He reported it was *ninety per cent. pure iron.* This was a revelation! I had been buying ore that ran forty per cent. iron, and when I chanced on a lot that ran sixty it was so good that I did not know how to handle it, and all the while these rolling mills were throwing away mineral that contained double the amount of pure iron than did the ore for which I had been paying out money.

"It did not take me long to decide that I wanted all the iron scale that the rolling mills in that district threw away; so I started a young man out with orders to buy, in his own name, all the scale the mills had, and to get three year contracts from them for all they might produce during that time, at a dollar a ton. Of course the rolling mill people laughed, but they took the young man's money—and then proceeded to grow wiser for the next three years."

LIBELED CHEMICALS

Nobody has any great objection to chemists, and the study of chemistry is regarded with calm by most people; but there is a strong feeling against "chemicals." The point is raised by "The Lancet," which points out that the potent word conveys to many minds the idea of a substance that is objectionable, especially when it is associated with articles of drink, food, or clothing. "Preserved with chemicals," "colored with chemicals," "flavored with chemicals," "glossed with chemicals," are expressions used disparagingly. Injury to health or material is implied. But this use of the word comes of ignorance.

Of course, there are preservatives which are

injurious to health. It is true, too, that the glaze of the tablecloth, napkin, shirt-front, or cuff is obtained in many instances at the expense of the material. Anilines, synthetic essences, bleaching powder, borax, and so forth are sufficiently accountable for such evils, and these things being "chemicals" have brought that word into general opprobrium.

But what objection is raised against the use of salt, because it is a "chemical?" And what else is it? If, again, the word "chemical" denotes an abhorrent substance, what justification can there be for the popularity of (for example) whisky and soda-water, a drink not objected to by many persons who do not like the idea of "chemicals?"

Soda-water is eminently a "chemical." It is merely a saturated solution of carbonic acid gas in water. The water may be of natural origin, but the gas is certainly not so. It is obtained in several ways, all of which are "chemical." The gas, for example, is obtained in some cases by burning coke; in others by acting on chalk or sodium carbonate with an acid. Even the whisky itself may be regarded as a chemical, since it is the product of distillation and consists chiefly of alcohol, which is a chemical substance. Soap, too, is a "chemical." So is cheese. It is simply the nitrogenous substance of milk separated by the addition of acid. Ink is a "chemical." Possibly we might manage to live without chemicals; but few of us would enjoy it.

Sea-waterproof cement, bearing the name of "Aegir," is a product of a cement works at Hemmoor, Germany, and it is claimed it can be used with economy and efficiency for works constructed in sea-water, tunnels, and other places, where ordinary portland cement will deteriorate. The raw materials used in its manufacture are: chalk containing 99½ to 100 per cent. of pure carbonate of lime; roasted quartz, very finely ground; and finely ground ferric oxide. The ferric oxide is obtained partly from bog-iron ore and from other purer iron ores. After the quartz and ferric oxide have been finely ground, all the three materials are worked together into a moist paste. After having been dried the mixture is burned to clinker in the ordinary way. In other words, it is a cement in which iron oxide replaces the alumina.

THE CONSULTING ENGINEER

What if it is customary to employ a consulting engineer in Europe, even for small installations? On this side of the pond it is not necessary. You know better than that. You employ an architect to draw up your building plans and specifications. You employ a doctor to tell you what is the matter with you when you are ill. You employ a lawyer to look after your legal affairs; but when it comes to engineering you attend to that yourself.

You have heard of this failure or that failure by this or that engineer, and therefore you are not going to risk a similar failure, but you are going to trust to luck, that kind providence which watches over the helpless, whatever the cause of their helplessness.

Did your attorney ever make a mistake at the bar and lose your case? Did you ever change doctors when yours failed to help you? Have you ever made any mistakes? Are engineers anything but human beings that they should be above making mistakes? And if this or that engineer does make a mistake is it a good reason to pass him by? Don't we all learn by the mistakes we or others make, unless we are fools? As a matter of fact isn't the man who has made a few mistakes the stronger for it if he has profited by them?

How can you tell whether you are getting a really good consulting engineer or not? Aye, there's the rub. Look up all of his work, if possible, and pick out one who has at least shown a disposition to make good his errors or failures, and remember no progressive man is without his enemies.—*Cold Storage and Ice Trade Journal.*

A COMPRESSED AIR SALVAGE FEAT

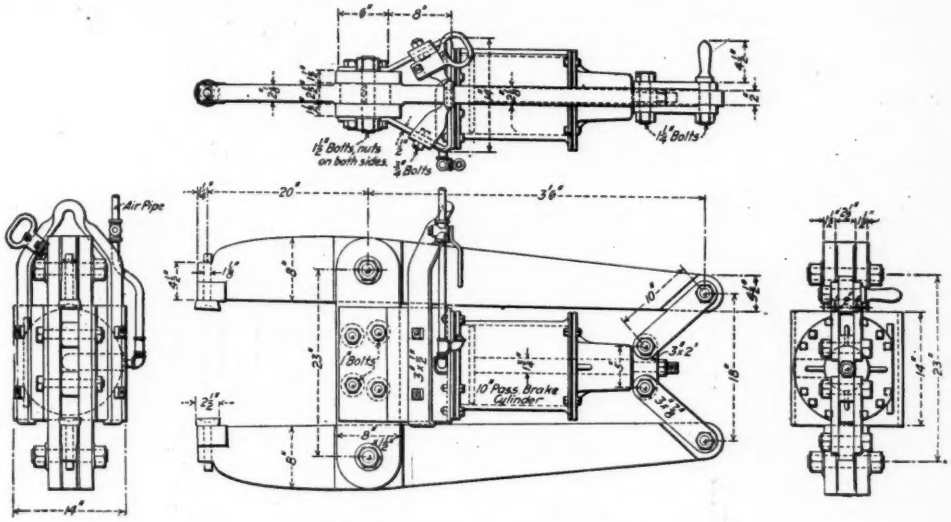
A record feat in marine salvage by compressed air is related by the chairman of the Liverpool Salvage Association. The steamer Veronese with a valuable cargo was sunk with a hole in her bow. The question was whether the old method of discharging the cargo and patching the vessel from the inside would have to be adopted or whether it could be avoided. It was decided to repair the damage under water, using pneumatic tools. Divers took the measure of the damage, and a steel patch was made on board the salvage steamer. Working on a platform twenty-eight feet below water, divers drilled the necessary holes in the ship. The plate was then sent down and fixed at

once by patent bolts invented by the association's surveyor. The cargo was not disturbed, and the ship was brought back to Liverpool through the Bay of Biscay in variable weather, without starting a leak.

A HOME-MADE PNEUMATIC RIVETER

The cut herewith, adapted from the *Railroad Age Gazette,* shows a simple but efficient riveting machine built at the Detroit shops of the Michigan Central Railroad, and in constant use there. There are two heavy, normally vertical, steel straps, between which are pivoted the working levers, and to which is also securely fastened the operating air cylinder, taken from a standard air brake pump. In the act of riveting, compressed air admitted behind the piston drives it forward and the toggle links move both levers equally. There is no adjustment provided for in the machine itself, but to adapt it to various thicknesses of metal and lengths of rivets the adjustment is made in the lengths of the rivet sets, and thus it is made to work to varying thicknesses from 1 to 8½ in. It is used for all classes of work, but principally for riveting truck bolsters and the yokes to drawbars. It has strength and power enough to close rivets up to 1½ in. diameter, and is used for all the sizes below that. For the largest rivets mentioned an air pressure of 100 lbs. is required, but 50 to 60 lbs. is sufficient for the usual run of work.

The machine as used is suspended from a crane by a chain hoist, which will raise or lower it as required. It hangs over a rotatable table 16 in. high, and 2 ft. diameter, upon which the articles to be riveted are placed and moved around at will. While cheap and home-made as indicated, the arrangement is convenient and efficient and the cost of operation and maintenance is slight.



HOME-MADE PNEUMATIC RIVETER.

AN AIR CONDENSING PLANT

The following account is from Power and the Engineer. It will of course be understood that the condensation in this case was entirely for the purpose of reclaiming the water, to be used over again in the boilers, and not at all for the production of vacuum, so that there was no reduction of steam consumption and no increase in the power developed.

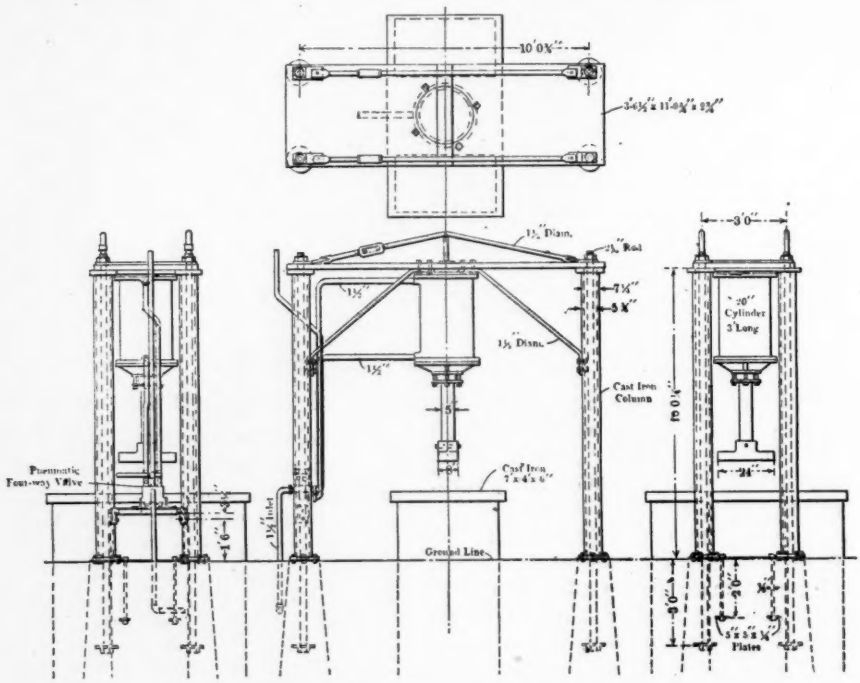
Some years ago in the oilfields of western Pennsylvania all wells were pumped by steam power, gas engines not being in general use at that time. In one particular locality the only water-pumping station was abandoned about this time as a nonpaying investment. As well water was unfit for boiler use, the use of the surface condenser and rainwater were the only means of obtaining the necessary water for operation.

The condenser was made of old 6-inch pipe that had outlived its usefulness in the oil wells. It was laid out on the ground in such

a way that the water of condensation would drain back to a barrel sunk in the ground under the pump which was attached to the crosshead of the engine. The amount of pipe required depended on the size of engine and the load it was carrying. Usually 600 to 800 feet were sufficient for each 20-horse power engine.

The exhaust steam of the engines was expelled into this pipe, where it would be condensed and returned to the pump; in some instances the loss was so small that from six to ten barrels of makeup water was sufficient for 40 horsepower of engines each twenty-four hours. The makeup water was supplied from storage tanks in which was caught rainwater from the roofs.

consumed annually in New York, including that for tugs and railroads within the city limits, amounts to 9,000,000 tons. This is more than one-eighth of the entire marketable output. The consumption of bituminous coal has been estimated at 6,500,000 tons a year. The strictly retail trade of the city amounts, at the least estimate, to 7,000,000 tons, or nearly 2,000,000 tons more than are sold at retail in the cold northwestern States of North Dakota, South Dakota, and Minnesota combined. The retail coal business of the city is greater than that of any State in the Union, except, of course, New York State. Of the total retail trade of the 10 largest cities, New York contributes more than one-third of the business.



LARGE PNEUMATIC STRAIGHTENING PRESS.

COAL IN NEW YORK

Nothing better illustrates the importance of New York city as a coal consumer than the voracity of the furnaces of the downtown skyscrapers. One building consumes 100 tons of coal a day, another between 75 and 100 tons, and still another 50 tons per day. The erection of a new sky-scraper of the average size means that at least 200 more carloads of coal must be brought into the city annually. The anthracite

PNEUMATIC DEVICES IN CAR REPAIRING

The devices shown in the two cuts here reproduced from American Engineer and Railroad Journal, are in use in the freight car repair shops of the Pennsylvania Railroad at Altoona.

LARGE STRAIGHTENING PRESS.

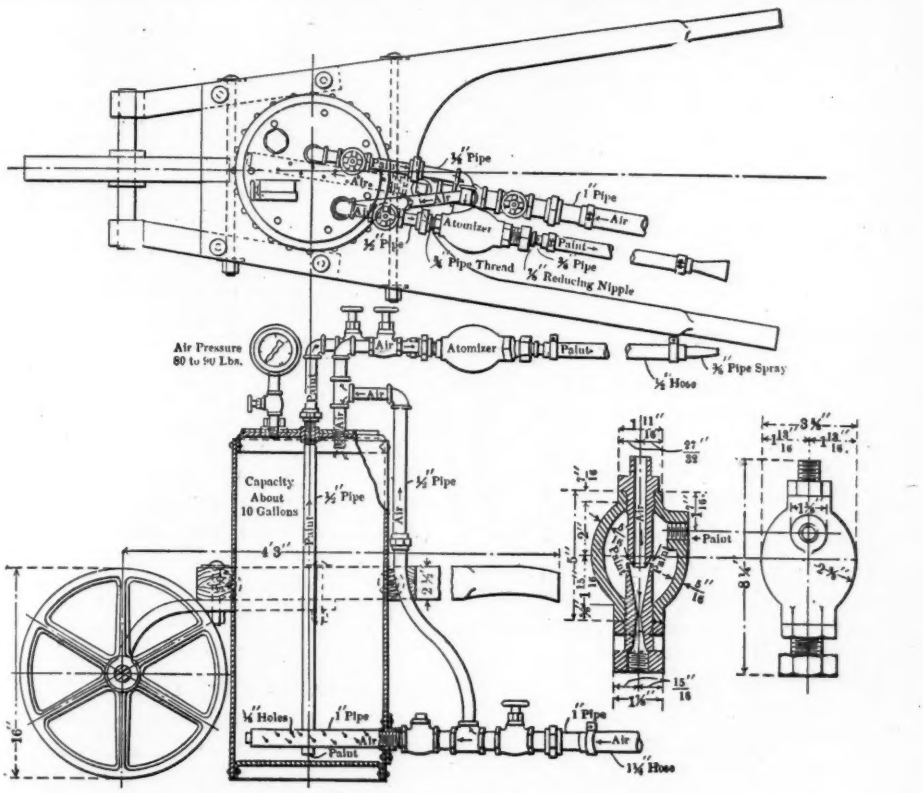
The badly damaged steel parts are taken from the steel car shop, the freight shop and the west bound repair yard to the smith shop

for straightening. This is done under a pneumatic press, which is shown in the cut. A frame-work supports the 20 in. air cylinder. Underneath the cylinder is a foundation upon which a cast iron table, 6 in. thick, 4 ft. wide and 7 ft. long, is placed. The air in the cylinder is controlled by a pneumatic four-way valve at one side of the frame work.

There are two of these presses just outside one end of the blacksmith shop. With the aid of a few cast iron blocks and two or three men to handle the sheets it is possible to straighten any part of the car and bring it back to its original shape. This work is done by piece work, the men being paid a certain rate per 100 pounds of material straightened. It is remarkable how adept the men become in doing this work. At one side of the press is a special oil furnace, with an opening 30 in. wide and 15 in. high, through which long material may be passed and any part of it heated locally. On the other side of the press is a large oil furnace for heating other parts. It has an opening 8 ft. wide and 21½ in. high at the center and is about 10 ft. deep.

PORTABLE CAR PAINTER.

When it is desired to paint a car complete it is taken to the freight car paint shop where the underframe and the body of the car are painted by the spraying machine shown in the cut. The principal feature of the machine is a paint tank having a capacity of about 10 gallons placed in a wheelbarrow frame work so that it can be moved about the shop. The arrangement of the apparatus and the details of the atomizer are shown clearly in the cut. The advantage of this type of spraying machine is that the atomizer is at the tank, and only one hose extends from it to the car. This machine works without waste. Very little surplus paint is found on the ground. Both labor and material are saved and better work is done. The paint is very uniformly distributed.



PORTABLE PNEUMATIC PAINT SPRAYER.

FAST DRIVING ON THE RAND

The following is abstracted by Engineering and Mining Journal from issues of South African Mining Journal, Dec. 2, 1908, and Jan. 9, 1909.

The record on the Rand, South Africa, for driving with two machines made at the Van Dyk Proprietary mine, where an advance of 226 ft. was made in 26 days and nights, has been broken, and even the record speed for driving made at the Simmer Deep mine in April, where three machines were used, has been surpassed, for at the Van Dyk Proprietary mine a drift has been advanced in 62 shifts, 9½ hours long, 323 feet.

THE VAN DYK RECORD.

One white man and five Kafirs worked each shift, using two 3¼-in. Ingersoll-Sergeant drills. One round was drilled and blasted each shift. The following were footages for each measurement period (Sundays, of course, being excluded): Oct. 26-31, 12 shifts, 55 ft.; Nov. 2-6, 10 shifts, 50.5 ft.; Nov. 7 and 9-13, 12 shifts, 66.5 ft.; Nov. 14 and 16-20, 12 shifts, 68 ft.; Nov. 21 and 23, 28 and 30, 16 shifts, 83 ft.; total, 62 shifts, 323 ft. The average number of holes drilled per round was 12; the average advance per round was 5.209 ft.; the average number of pounds of gelatin used per foot was 8.513.

No bonus of any description was attached to the work either for white men or Kafirs, the Kafir being paid 1s. 7d. per shift. No special conditions were used to aid the work, and no endeavor was made to secure specially long rounds, as ordinary length steel was used. This performance is certainly remarkable.

COMPARISON WITH THE SIMMER DEEP PERFORMANCE.

It is interesting to contrast the details of this work with the figures for the Simmer Deep achievement. At that mine a drift was advanced 294 ft. in 61 consecutive shifts of 10 hours each. The size of the drive was 5x7 ft. One white man and six Chinese were employed on each shift, and they operated three Ingersoll-Sergeant drills on a bar. One round was drilled per shift, and the average footage per round was 4.82. The number of feet broken per case of gelatin consumed was 4.52; in other words, 11.06 lb. of gelatin were used per foot. Of the 61 rounds drilled, 59 had 14 holes each and two had 12 holes each. The air pressure at surface was 80 lb. per sq. in. It is interesting to note that special measures were taken to cool the drift after blasting and to eliminate dust. A water-pipe was connected with the air-pipe, so that the drive could be cooled, and the broken rock wetted without loss of time. After blasting the cut holes, water was forced by the air into the face, so that the contractor on returning to blast the round found the drive quite cool and free from dust.

Both these performances reflect the greatest credit not only on the miners, but also on the management and the Ingersoll-Sergeant drill. It should be taken into account that only two machines were employed at the Van Dyk, as against three in the Simmer Deep, and that the shifts worked at the former mine were half an hour shorter than those worked in the Simmer Deep.

FAST DRIVING AT THE VOGELSTRUIS CONSOLIDATED DEEP.

At the Vogelstruis Deep during November 1908, a drift was driven with two machines 272 ft. This was done by six white men and six Kafirs (both shifts). The drift was 6 ft. 6 in. in the clear above rails by 3 ft. 6 in. and 4 ft. 6 in. wide in the clear. This also is a notable performance, but it was surpassed in December when the same drift with two machines on a bar was advanced by six white men and six Kafirs 305 ft. in 31 days. Twelve holes were drilled to the round. The drift is at a depth of 3000 feet.

EUROPEAN WATER POWERS

A German engineer, Otto Mayr, has compiled a list of available European water powers, reaching a total of 34,157,600 h. p. Norway leads with 7,525,000 h. p. available, and 301,000, or 4 per cent., utilized; then follow Sweden with 6,750,000 available and 200,000, or 2.9 per cent. used; Italy, 5,500,000 available and 464,000 used; France, 5,524,000 available and 1,190,800 used; Austria, 5,125,000 available and 450,000 used; Germany, 1,677,600 available and 503,300, or 30 per cent., used; Switzerland, 1,500,000 available and 380,000 used. For the whole of Europe 10.41 per cent. of the available water power is used. Later records for Italy show 15.27 per cent. utilized, of which 89 per cent. was transformed into electrical energy and 11 per cent. was applied directly.

ELECTRIC AIR DRILL WORK—THE DRILL FOR CITY CONTRACTS

In New York city the rock drill is always in evidence. The city is built upon rock and where excavations are to be made for new buildings, drilling and blasting must be resorted to. The steam driven rock drill has been employed so long for this purpose that it is still very generally employed, just as there are still in the city at least a dozen lines of horse-cars.

The Electric Air drill has so completely demonstrated its economy, reliability, and convenience that those sufficiently informed must greatly wonder that it has not yet found employment in New York. The following timely and pertinent account of Electric Air drill performance was contributed to the columns of Engineering Contracting by Mr. W. L. McLaughlin, general manager of the Mogul Mining Company, Deadwood, South Dakota:

The electric air drill consists of an electric motor that runs an air pulsator, which furnishes air to the drill, which is mounted either on a tripod or column. The drill strikes a very powerful blow, and, for this reason, the bits are blunter or thicker to avoid breakage. The drill used by the Mogul Mining Co. was a No. 4D. For this type of machine a 4 H.P. motor is used. The drill cylinder is 4¾ ins. in diameter. The length of the stroke is 7 ins. The machine is adapted to drilling vertical holes to a depth of 10 ft. Its work will compare favorably with a 2¾ in. diameter steam or air drill.

During the month of June, 1908, the Mogul Mining Company used this drill for cross cutting work in their mine. During the month the drill was worked for 99 hrs. After the first 20 days work a new man was put to running the machine, with the result that for 3 or 4 days less work was done by the machine, but after that he was able to operate it at the average of the drilling record. In all, 555 lin. ft. of hole were drilled. This gives a rate of 5.6 lin. ft. per hour.

The cost of operating the drill was as follows:

1 miner, 99 hrs., at 50 cts.	$49.50
1 helper, 99 hrs., at 25 cts.	24.75
Total	$74.25

A miner and his helper operated the machine. This gives a cost of 13.4 cts. per lin. ft. The cost for the power used is almost negligible, Mr. McLaughlin states, and for the conditions in their mine this machine effects a great saving over the drill run by the ordinary air compressor. The rock drilled was quite hard, and considering the rates of wages paid, the cost is very reasonable.

The cost of maintaining the drill for the first 10 months was as follows:

New parts bought:	
6 springs	$2.01
1 air gage	2.65
12 cup leathers	10.25
Fittings	12.25
Total	$17.31
Labor	39.00
Grand total	$56.31

For the first two months no repairs were made to the drill. The average monthly cost of repairs to the drill was $5.63. This makes a little over 1 ct. per lin. ft. of hole drilled during June, as a charge for drill maintenance. This is a low cost, especially when it is remembered that in comparing this cost with others, the cost of maintaining and repairing, the power plant needed for other style of drills, must be included.

City contractors always have an electric current available, and they should find the electric air drill especially adapted for drill purpose. It is still a common thing to find contractors for sewer and water pipe trenches doing tll their rock drilling by hand. There is scarcely any class of rock work that requires so many lineal feet of drill hole per cubic yard as narrow trench work, yet, in the face of this fact, hand labor is extensively employed by city contractors. The principal reason for this adherence to hand drilling is found in the fact that the installation of a power plant and pipe lines, followed by the frequent shifting of the plant along the street, runs up the cost of steam drilling in narrow trench work to a point that is frequently above the cost of hand drilling. Then, too, there is often a lack of room in the street for installing the steam boiler, etc.

It seems to the editors that a drill of the type described in this article is admirably adapted for rock trench work, for the electric current can be tapped at intervals and a long coil of insulated wire be used to feed the small

motor of the air pulsator that operates the drill. There is no cumbersome power plant to install and shift, and, instead of a heavy pipe line, there is simply a light line of wire that conveys the current.

LARGE COMPRESSED AIR PLANS FOR SOUTH AFRICA

An arrangement has been made between the Victoria Falls Power Company and the promoters of the Harper power scheme, whereby the contracts for the supply of power to Eckstein mines secured by the latter are taken over by the "Falls" Company, which will erect another electric power station to meet the increased demand. The contracts to supply electric power to all the mines of the Eckstein Central Administration and Rand Mines, Ltd., groups involve the installation of plant of a capacity of approximately 84,000 kilowatts. (112,560 hp.)

THE COMPRESSED AIR SCHEME.

The most novel feature of the new scheme is the provision for central compressed air power generating stations. It is proposed to start with at least three of these: one will be situated at Brakpan, and will be steam-driven; another will be situated at the Simmer Deep, and a third at the Robinson Central Deep. The first will supply compressed air power to all the mines of the Far East Rand—the New Modderfontein, the Modder B, and, no doubt, the Brakpan itself. The second will supply the Germiston mines, and the third the mines of the Central Rand. Later, no doubt, other stations will be erected to cope with the increasing orders from mines about to start work, and possibly from some of the existing mines that have not yet considered making contracts. This compressed air plant will be in 8,000 h. p. units, consisting of 3,000 h. p. turbo-compressors for the first stage, compressing air to about 30 lbs. per sq. in., and reciprocating two-stage compressors for the second and third stages of 5,000 h. p. The plant will be driven by synchronous motors supplied with power from the chief power station.

The combination of turbo with reciprocating compressors overcomes the difficulties experienced in connection with the running of turbo-compressors in parallel. The turbo compressors used may be of either the Rateau or Zoelly type. The maker of the latter is the firm well-known in the engineering world as maker of turbines. Indeed, a turbine of the make in question is now employed in the Brakpan station.

MEASUREMENT OF AIR.

The compressed air supplied to the mines will be metered, with displacement or inferential meters. Both of these methods of measurement will be tried, and the more satisfactory one adopted. It is unnecessary here to draw the moral that with compressed air purchased by the unit, considerable economies can, and no doubt will, be effected in its use. The air mains will be welded by the oxygen-acetylene system.

AIR PRESSURE.

A noteworthy point in connection with the system is the fact that the air pressure delivered at the point furthest from the compressor will be guaranteed at a pressure of 100 lbs. per square inch. The high pressure is confidently anticipated to make for economy and efficiency. That so high a pressure increases the wear and tear of drills is, however, generally admitted; and the result is likely to be the gradual increase in the number of small light machine drills employed on the fields.—*South African Mining Journal.*

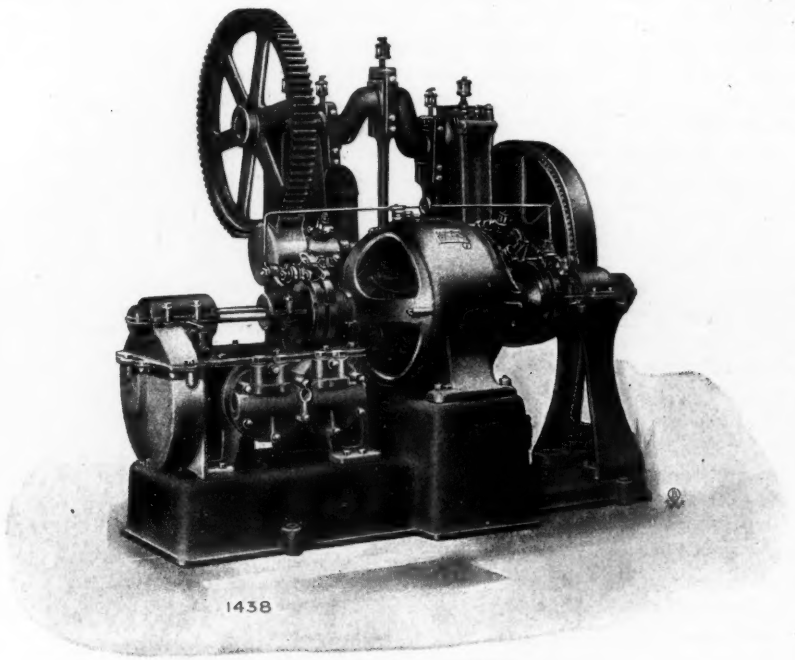
NITRIC ACID FROM THE AIR

The Badische nitric acid furnace consists of a long tube traversed from end to end by an electric arc discharge. Air is blown through this tube, being admitted tangentially so as to give it a whirling motion. This is found to raise the efficiency, no doubt by insuring that all portions of the air blown through shall come within the sphere of action of the arc. The entering air is systematically preheated by the outgoing reaction gases. Since the autumn of 1907 an experimental plant of 2,000 h. p. capacity has been in operation at Christianssand, Norway. This comprises three furnaces of 600 h. p. each. The length of the arc is no less than five metres (16½ feet). The life of the furnaces is said to be fairly long. The lower electrode is gradually moved up as it wears away. It is claimed as a special advantage of the system, that it gives a concentrated gas with a good yield and high power. Owing

to the steady character of the arc, its prejudicial influence upon the power factor, especially marked with intermittent arcs, can be reduced to a minimum. As compared with the principal forms of furnace designed by other inventors, the Badische apparatus is distinguished by great simplicity, the absence of moving parts and of electromagnets. A plant is in course of erection by the Badische Company at the Rukwan Falls. This is planned in the first instance on a scale of 120,000 h. p., with the project of enlarging it to double this capacity in the future.

COMBINED AIR COMPRESSOR AND WATER PUMP

The half tone shows a combined electrically driven air compressor and water pump used extensively in connection with automatic sprinkler systems, water supplies for buildings where an elevated tank is dispensed with, and for hydraulic elevator service. The combination is especially notable for its compactness, showing an important saving in floor space and foundations. The compressor, a pump of standard make and a driving motor, are all mounted upon a common sub-base. The



AIR COMPRESSOR AND PUMP.

pump and compressor are operated independently of each other, the change from one to the other being readily effected by throwing a switch, this single switch operating electric clutches for both. The motor is of the direct current, shunt motor type, designed and built especially for this service. It operates at low temperature and will stand heavy and continuous service. The apparatus is approved by the Board of Underwriters and is recommended by their engineers. It is built in several sizes, for water pressures up to 150 lbs., and 90 lbs. air pressure, by the National Brake & Electric Company, Milwaukee.

We are inclined to doubt if anybody can say whether a new project is overcapitalized or not; the test is operation. If the Humdrum Valley Railway, facing competition, either of carriers or of markets, real or potential, is able to pay its charges, and to earn five per cent. on its stock, we maintain stoutly that it is not overcapitalized, and the simplicity of this meth- of of calculation lies in the fact that we do not know, nor want to know, how much it cost to build the road, what the replacement value is, or how much stock is outstanding.—*Railroad Age Gazette.*

MECHANICAL IMITATION OF GRAVITATION-NEGATIVE GRAVITY

Prof. Arthur Korn, according to an account in the *Westminster Gazette,* is said to have a machine which imitates the action of gravital force and apparently demonstrates that gravitation is a mode of motion.

It is assumed that gravitation is the result of the vibration of elastic bodies in an inelastic medium. The machine spoken of is simple. A metallic globe, fitted with a window for observation, is united by tubes with a cylinder, one end of which is closed by a membrane and to this membrane is attached an electro-motor, which, by alternately pushing and pulling the membrane, makes rapid pulsations. The metal globe contains two air-filled india-rubber balls of different sizes. The larger one is fixed firmly to the inside wall of the globe; the smaller is free to move whither it likes. The whole apparatus is then filled with water, and the motor set to work. Each time the membrane is pressed in, the increased water pressure causes the rubber balls to contract, and each time the membrane returns to its original position the relaxed pressure of the water causes the two balls to expand. The motor is set working so quickly that these pulsations become inconceivably rapid vibrations, and the contraction and expansion of the balls is invisible to the eye. As water is practically incompressible, Prof. Korn thus obtains the conditions he needs—he has two elastic bodies vibrating in an inelastic medium. Then the phenomenon looked for occurs. When the vibrations attain a certain speed, the smaller ball, impelled by a mysterious force, begins slowly to move through the water to the larger ball, and gradually increases its speed, exactly as the apple observed by Newton increased its speed as it fell nearer and nearer to the ground.

So far, this was merely a puzzling phenomenon; but that it was gravitation, and no other force, which drew the balls together was soon proved. Measurements showed that the bigger ball attracted the smaller exactly in accordance with Newton's law, or in inverse ratio to the square of the distances between them. It became, therefore, possible to construct an exact working model of the solar system in water, in which the planets should all move in their appointed paths without any visible support or externally-applied power.

Prof. Korn's researches do not end here. He had shown why matter attracts matter, but he had to solve the problem why matter also repels matter. Why is it, for instance, that comets, after rushing directly towards the sun from the depths of infinite space, never collide with it, and invariably return whence they came? To this problem the professor again applies the musical-vibration theory. Just as there are over-tones in the violin string, so in the vibrations of matter there are over-vibrations. These over-vibrations come into play when the attracted bodies come too near, and their effect is immediately repulsive. They are counter-gravitational in their effect, and operate in this way also only in an inelastic medium like water. In an elastic medium the vibrations of matter would have no attractive or repulsive effect; hence it follows that gravitation depends entirely upon the fact that all the heavenly bodies are surrounded by inelastic ether.

The results which Prof. Korn produces are of course incontrovertible, but his assumptions and deductions may still be questioned. The inelastic ether would seem to be especially difficult of acceptance, however much Prof. Korn may require it.

WEALTH IN WASTE

A more striking instance of the value of the utilization of a hitherto waste product would be difficult to find than that of the Tennessee Copper Co., which, in order to develop some system for preventing the destruction of vegetation by the sulphur fumes generated in its copper smelting plant, has developed a great sulphuric acid industry.

When the State of Georgia undertook to compel the Tennessee Copper Co. to prevent the injury to the vegetation of the surrounding country from the sulphur fumes, the decision of the courts was in favor of the State, but it was suggested that time should be given to the company to develop some system for preventing the injury of which the State had complained. Out of this grew a system or process for the making of sulphuric acid from gases of its smelting furnaces, giving to the Tennessee Copper Co. an estimated output of about 300,000 tons of acid per year. The marketing of so large an output was for a while a problem, but out of this condition there developed a situation which has now resulted in the organization

of the Independent Fertilizer Co., with a capitalization of $75,000,000. This company, in addition to buying the output of sulphuric acid from the plant of the Tennessee Copper Co., has also purchased a large number of independent fertilizer plants, and will build a number of others.

Another company operating in the same copper field as the Tennessee is likewise preparing for the manufacture of sulphuric acid. Thus out of that which had not only been a waste product, but an absolutely injurious product, chemical skill, backed by great capital, has created a new industry, which will result not only in the investment of many millions of dollars in the development of copper mining and acid manufacturing as a by-product, but will also result in the building of new fertilizer factories and the reduction in the cost of fertilizers to Southern farmers.

This is one of the most interesting events in recent metallurgical history, fraught with very great advantages to many lines of industry in the South.

THE EVERLASTING INVENTOR

By W. H. Booth.

Most inventors lack that sense of proportion which helps a man to keep himself from looking the ass so many of us really are. The same inventions are constantly coming up to the top, but there is a new inventor and a new set of promoters, a new man with a fur coat. I wouldn't give a red cent for any invention unless at least one man, in the miscellaneous crowd that attends at the demonstration, wears a fur coat, or at least has fur collar and cuffs to his overcoat. He adds that one touch that makes the inventor so sure he has fallen among honorable city financial men of standing. At one time it is a rotary engine. Now, of late years, there has sprung up a new development of rotary engines. None of your common racheting quick-sliding steam-trapping sliding-door abutment valves, but genuinely artful and ingenious mechanical motions which get behind the steam and make it labor expansively for the benefit of the promoter. Some of them are really most ingenious, and within limits there are now rotary engines that will work very well. And the hopeful inventor measures up his little 10-horse buzzer, length, breadth and height, and in a few minutes he has shown you that put into the "Mauretania" it would knock spots off the present steam plant very completely.

Most of the men connected with these affairs are busy buying reports from consultants, for blocks of shares and promises. They come to me often enough with little things that are good enough as little things, but all of them want reports saying that the little thing only needs multiplying by 10,000 and it will drive the "Lusitania." A tear comes into their eye when I give them a report of facts and warn them that Lucy is not for them.

Then there is the steam boiler which, "by a peculiar adaptation of a well known but little recognized law to the evaporation of certain liquids has disclosed unsuspected merits in a quite novel cycle of operations from which great results may confidently be anticipated." At least, this sentence explains the sort of impression that is left on my mind by reading some of the prospectuses. It makes me think of hiring myself out to some honorable promoter as a writer of prospectus catch sentences. Why should such a gift of language lie fallow? I think it a beautiful sentence. As a rule if one succumbs to the temptation to go and see the wonderful invention at work there is much to be learned.—*Power and the Engineer*.

THE RUEPING PROCESS FOR CREOSOTING TIMBER

In this process the seasoned wood is subjected to treatment, for from half an hour to one hour, of an air pressure of from 60 to 75 pounds (depending upon the wood), so that all cells will be filled with compressed air. Without reducing this pressure in the impregnation cylinder, the warm impregnating fluid, which is usually creosote (on account of its great antiseptic qualities) is then forced from the pressure cylinders or tar reservoir into the impregnating cylinder by means of a somewhat higher pressure, or by gravity when the pressure is kept the same in the reservoir as in the cylinders.

When the impregnating cylinder is full and the wood is immersed, the pressure pumps are started and the fluid is forced into the wood under pressure, rising gradually from 60 or 75 pounds to 150 or 250 pounds, depending on the nature of the wood under treatment. Under the increased pressure the fluid penetrates into all the cells of the wood, soaking or impregnat-

ing the cell walls, and compressing still more the air formerly put in at 60 to 75 pounds pressure.

When the wood is sufficiently impregnated with the fluid (the quantity being usually specified in pounds per cubic foot), the expansive energy of the air in the cells forces as much of the impregnating fluid out of the wood as does not adhere to the cell walls. This excess is allowed to flow from the impregnation cylinders back and into the creosote tank.

Therefore, the distinctive feature of the process lies in the fact that no more fluid remains in the wood than is necessary for impregnating, coating or saturating the cell walls. Therein is the commercial advantage of this process.

From comparison with the customary creosoting process of impregnation, it is claimed that in the Rueping process 4 to 5 pounds of creosote per cubic foot will give a more uniform distribution of fluid than 10 to 12 pounds applied in the old way. Taking the average hewn soft pine ties at 3 cubic feet each, there will be a saving of about 20 pounds of creosote per tie.—*Industrial Progress.*

FRESH AIR

Few people have any idea how little impurity it takes to seriously affect the efficiency of the atmosphere. There is normally .04 per cent. carbon-dioxide in the air. If this part is increased to 3 per cent. lights will not burn.

Just think! Only 3 per cent. impurity (reducing oxygen from 20 per cent. to 17 per cent.) makes the air totally useless for combustion and absolutely unfit for continued respiration. This knowledge is fertile in hints for the betterment of many conditions. It is, of course, obvious that greater care should be exercised in ventilating all places where men work. But we knew this before. Bad air is a thing which requires no chemist to prove. No one knows better the evil effects of bad air than one who has worked in it.

What has not been so well understood is that more care should be exercised in providing good air for boilers or other combustion apparatus. Rarely is any thought given to the quality of air given a furnace. Too often the air draft draws air from the floor of the boiler room, which in turn opens off a room crowded with workmen. The air from such a source must be heavily charged with carbon-dioxide, moisture and other impurities, and it is no wonder that the fireman often complains that the coal burns badly. True, it is better that this foul air be drawn away from the workmen than that the boiler should burn well; but the scientific thing to do would be to ventilate the workroom and also to furnish good, fresh air to the boiler.—*Mining Science.*

FREE WATER IN THE EARTH'S CRUST

In the United States geological survey Water-Supply Paper 160, M. L. Fuller considers the subject of the total free water in rocks of various types. "Free water" is defined as the water that occupies the joints, solution passages, pores, or other openings in the rock, as distinguished from the chemically combined water in the minerals of the rocks. The free water has a more or less definite circulation even in the densest rocks, while the water in combination is not in liquid form, but is a part of the mineral compound itself. The free water should also be distinguished from the available water, for some materials, like clay, hold great quantities of water and yet give up only insignificant amounts. It is, in fact, possible for a rock to hold from 35 to 40 per cent. of water and yet yield almost none at all to a pump—that is, almost none of its water is available.

Mr. Fuller concludes, after consideration of all the available factors, that the total free water held in the earth's crust would be equivalent to "a uniform sheet over the entire surface with a depth of a little less than 100 feet (96 feet). * * * If the average depth of the ocean is 14,000 feet, its volume is equivalent to a layer 10,500 feet deep over the whole earth's surface. The underground water would therefore be roughly only one-hundredth of the volume of the ocean." This proportion has been computed by other investigators to be from one-half to one-eighteenth.

Mr. Fuller says: "There is a general tendency to overestimate the amount of water in the ground owing to the impression of great volume which a large well conveys, the fact that a large area is drained being frequently overlooked. A study of the conditions in deep wells in the United States leads the writer to believe that the average amount of water present in the earth is probably under rather than over the amount estimated.

THE LEAK WAS AT THE OTHER END

In the plant where I am employed we have a small belt-driven air compressor, supplying air at 80 pounds pressure to molding machines. The capacity of the compressor is about 35 cubic feet per minute. It has an automatic governing device which holds the pressure at any predetermined point within its capacity.

While on my vacation this machine refused to deliver the quantity of air needed and no amount of coaxing on the part of my assistant, who was in charge, would get it to do so. A machinist was called in, who stripped the machine and on using his calipers found the cylinder to be out of round about 0.005 or 0.006 of an inch. This he claimed was the cause of the trouble, and wanted the cylinder bored and a new piston fitted.

Upon my return a few days later I overhauled the machine, but could find no reason for the failure to do the work, as the cylinder, piston and rings were in good condition. I concluded that air was being wasted somewhere about the plant, and looked for leaks for several days. At times the pressure would go to 65 or 70 pounds and at others down to 25 pounds. Finally a search resulted in locating the trouble. It was in a beautifully arranged ventilating system using a sort of spray jet, having a head with nine 1/16-inch holes and was supplied by a 3/8-inch pipe with a valve to regulate the amount of draft. This device was not used all the time, which accounts for the fact that at times we could get our air pressure about up to normal.

The ventilating scheme was put in without my knowledge, or I should have known that it was the cause of the many hard names I had to stand for from the foundry foreman. The moral I have learned is, in case of failure of supply from no visible cause look for leaks. Also look for the inventive chap with a club. —*Power and the Engineer.*

A SMALL AUTOMATIC ELECTRIC AIR COMPRESSOR

There seems to be a vast field of employment for a small, always ready, entirely automatic air compressor working at a comparatively lower pressure, say not to exceed 30 lbs. gage. It is wanted by physicians and dentists, in hospitals and barber shops, by artists and photographers for air brushes, to supply air blast for brazing and soldering, for inflating pneumatic tires, for drawing oils and acids, and, last but far from least, for cafes and saloons for drawing and preserving beer and ale.

The air compressor shown in the half tone very completely fills these various requirements. The column of the machine forms an ample air receiver, and the complete machine is furnished ready for immediate operation, requiring only to be connected to the electric circuit and to the air distributing pipes if such are required. The compressor is direct connected to the motor which runs at 325 R. P. M. All the working parts are enclosed in a strong glass globe, on top of which is a glass jar containing water through which the air is drawn, removing dust and other impurities.

AUTOMATIC ELECTRIC COMPRESSOR.

The automatic cut-out so regulates the operation that the compressor runs only when the air is required to maintain the pressure in the tank, and the work stops automatically when the predetermined pressure, 14, 25 or up to 40 lbs. is reached as may be desired. A run of about one minute will raise the pressure in the tank from 15 to 20 lbs. Each machine has a 6 c. p. red electric lamp which lights up when the motor runs, making a novel and attractive feature. The compressor is built by the Norwig Manufacturing Company, Cincinnati.

ICE TO PREVENT FREEZING

A government expert has devised a novel method of keeping a car or compartment comparatively warm in zero weather; not by fire, but by the utilization of ice. A well-insulated car is fitted at each end with four galvanized iron cylinders reaching from the floor to the top of the car. In summer these cylinders are filled with ice and salt to keep the car cool. In winter they are filled with ice to keep the contents of the car from freezing. Ice is normally at a temperature of thirty-two degrees Fahrenheit, and changes temperature reluctantly, being a poor conductor of heat or cold. Consequently when zero weather prevails outside, the cylinders of relatively warm ice prevent the escape of heat; in other words, they maintain the temperature within the car. Another method whereby ice is employed for protection against cold consists in throwing a plentiful stream of water on the car when the temperature is near zero, which freezes at once and forms a complete coat over the car. The action of this ice is the same as in the case of cylinders filled with ice. A similar plan is frequently adopted in the transportation of bananas, a fruit particularly susceptible to cold.

AN ENGLISH SAND BLAST TUMBLING BARREL

An interesting machine of this class is in successful operation in English foundries, and we are indebted to Engineering for the following description. The barrel is 27½ in. in diameter and 35½ in. long, placed horizontally in a casing and supported on two chain-driven rollers. The drive is through shaft and bevel gears and a second chain from a short shaft carrying fast and loose pulleys 23½ ins. in diameter and of 3½-in. face. The interior of the barrel is fitted with a spiral conveyor, and the castings are carried by this along the drum, being fed in on one side through a hopper and discharged from the other through a door. The air for the blast is led into two nozzles fitted with chilled-iron nose-pieces, which are easily renewable. The sand escapes from the drum through perforations, falling into a trough, whence it runs down to a narrow pit. From this a spiral conveyor working in the trunk casing at the back of the machine carries the sand to a bucket elevator, which throws it into a chute leading back to the sand-blast apparatus. A hole is cut in the cover of the tumbler chamber for a connection with an exhaust fan, by which the fine dust is carried away. This machane will handle 1,100 lbs. of grey iron castings per hour. A large size, 35½ ins. in diameter and 43 ins. long, is provided with four nozzles, and will handle 1,800 lbs. of castings per hour. The air pressure, when sand is used, is 15 lbs. per sq. in., and 30 lbs. when iron grit is used. The small machine uses 70 cu. ft. of air per min. and the larger one 140 cu. ft.

HOW NOT TO THAW DYNAMITE

This season's batch of fatalities attending the thawing of dynamite seems, up to date, to be less than usual. The latest horror in this line comes in a dispatch from Glendive, Montana. With work almost completed, it says, the first real catastrophe in connection with the construction of the lower Yellowstone irrigation canal occurred when general foreman Jones Donaldson was killed and a laborer was fatally injured by an explosion of dynamite.

A fire had been started to thaw out 15 sticks of dynamite when one of the men called Donaldson's attention to the fact that some of the dynamite was burning. He ran to the spot to save as much of the dynamite as he could and was bending over it when the explosion took place. His face was blown away and one arm and one leg were torn off. The other man who was running to help Donaldson was only a few feet away. Flying rock broke his collar bone, penetrated a lung and inflicted abdominal injuries.

A LOCALIZED MINE EXPLOSION

An explosion, fortunately limited in action and effect, occurred recently in the Sewickley mine of the Keystone Coal & Coke Company at Madison, Pa. There was a bona fide explosion, but it was confined to two rooms where two men were killed, while the three hundred men distributed through the mine escaped. The detonation felt throughout the mine caused a rush to the surface, and fire bosses went into the mine and brought out the two bodies. Not a trace of gas was found, the bodies were not marked and each gave evidence of suffocation by fire damp. It was decided that the explosion was the result of the firing of a shot before the dust in a room had been allowed time enough to settle.

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

Established 1896

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NO TIME FOR A BUREAU OF MINES

Nearly a year ago the House of Representatives passed a bill creating a Bureau of Mines to be devoted to purposes of investigation and the dissemination of information of vital interest to one of the most important of our national industries. There was no proposition for federal inspection or any interference with state supervision. Of the necessity for such a bureau and for the increased safety and efficiency which it could be instrumental in securing there can be no question. While experts are all agreed that the natural conditions at our mines should make them the safest in the world, they are in fact just the reverse of this. During the past 19 years nearly 30,000 men have lost their lives in mine disasters, and a much greater number have been maimed and permanently disabled. The death rate has more than doubled since 1895. In 1906 the number of coal miners killed in France was less than .84 per thousand employed; in Belgium, less than .94; in Great Britain, 1.29; in Russia, 1.80; in the United States, 3.40 per thousand, and for the last three years our average has been much higher.

The bill passed by the House failed in the Senate "for want of time," and a new congress will have to begin again at the beginning. *Copper Age*, Butte, Montana, speaks of the situation as follows:

It is difficult for western mining men and coal miners of the east to understand why the senators should ask for so much time upon the question of a mining bureau. While United States senators are sitting back in comfort and ease and free from all danger, waiting for more time, miners are being killed by accident at the rate of more than three for every thousand employed during each year, and mining enterprises all over the country are not receiving just recognition at the hands of congress. If an explosion should occur in one of the cloak rooms, committee rooms or toilet rooms of the capitol building and kill, or even slightly injure, a member of the senate, there is not the least doubt but that all of the machinery of the government would be suspended if necessary to inquire into the accident and remedy the defect by providing against a recurrence of the explosion. But it is different if several hundred ordinary miners lose their lives in a mine. Little notice is taken of the occurrence

and it does not even call the mining bureau bill from its peaceful slumbers in a senate pigeon hole.

SAFEGUARDING PENNSYLVANIA MINES

A new mining code, prepared by a commission appointed by Governor Stuart, is now before the Legislature of Pennsylvania and is being considered by the House Mines and Mining Committee to whom much interesting and important evidence is being presented. At a recent hearing Francis Feehan declared without qualification that the explosions in the Darr, Naomi and Marianna mines were due either to the use of electrical machinery or "open lamps," and he urged that the bill be amended so as to prohibit the use of electrical machinery or the open or naked lights which, under certain restrictions, are permitted by the pending measure. The assertion of President Feehan that the five hundred men killed in those disasters would be alive to-day had the State properly safeguarded them was not disputed.

Speaker Cox inquired if there had been more explosions since the installation of electrical machinery. Mr. Feehan said that the number of explosions had greatly increased, and that the fact that electrical apparatus is a menace to life is shown by the proposed action of the mine owners of Great Britain to discontinue the use of such machinery.

BILL FOR CAISSION WORKERS

A proposed amendment to the labor law of the State of New York and now before the legislature relates to the employment of men in caissons, tunnels and other places where compressed air is used. The bill provides that no employe is to be permitted to work in any place where the pressure exceeds 50 lbs. to the square inch. Medical officers must be in attendance at all times; employes must be examined before being permitted to work, and reëxaminations will be provided for; persons addicted to the excessive use of intoxicants to be prohibited from engaging in the work; persons who have never worked in compressed air are to work only half the periods prescribed for others, and hot and cold water baths and dressing rooms must be provided.

PROBABLE CAUSE OF AIR COMPRESSOR EXPLOSIONS

The following correspondence completely explains itself:

Editor of *Power and the Engineer*:

On one occasion I had to look for the cause of two air-compressor explosions. The air was compressed to 17 pounds per square inch. In both cases the pipes were ruptured. Various theories were investigated, such as simple failure of the pipe, oil spray in the pipe, oil ignition at the extreme end, poor grade of oil, leaky discharge valves. The last-named offered the most plausible explanation, as air which had been compressed evidently leaked back into the cylinder where it became recompressed. This recompression will make it hotter and hotter until it either reaches a point where radiation will take the heat faster than the temperature can rise, or the temperature will rise until the oil catches fire. The best of oils will take fire if heated enough.

F. W. Hollmann.

Baltimore, Md.

Editor of *Power and the Engineer*:

I note in your columns a letter from F. W. Hollmann under the title, "Probable Cause of Air Compressor Explosions," in which he suggests leaky discharge valves as the "most plausible" explanation of the cause of certain destructive compressed-air pipe explosions. As far as my knowledge extends, the letter does not suggest even a *possible* cause of such explosions.

The letter says: "Air which had been compressed evidently leaked back into the cylinder, where it became recompressed. This recompression will make it hotter and hotter until it either reaches a point where radiation will take the heat faster than the temperature can rise, or the temperature will rise until the oil catches fire."

In the case under consideration the air was compressed to 17 pounds gage and, with an initial temperature of 60 degrees Fahrenheit, the temperature after compression would be 190 degrees. If the air at this temperature could be recompressed, the final temperature would then be much higher, and if this operation could be repeated many times, the theoretical temperature attained might go as high as the most unbridled imagination could carry it; but no such result could come from leaky discharge valves.

The discharge valves would have to be in very bad condition to leak back 5 per cent. of the air compressed per stroke, and this return leakage into the compressor cylinder would occur during the intake stroke, continuing perhaps, if the leakage was very bad, during a small portion of the compression stroke; not far, because with adiabatic compression, full pressure would be reached when the piston reached the middle. When the piston starts for the intake stroke the air in the clearance space, heated by compression, must first re-expand down to atmospheric pressure and, coincidently with its re-expansion, its temperature will fall entirely back to what it was before the compression began. The air leaking back through the discharge valves also re-expands and its temperature falls correspondingly and, mingling with the incoming air at atmospheric pressure and temperature, the temperature of the whole cannot be raised appreciably by the leakage. This air which has leaked back becomes an inseparable part of the cylinderful, and when the mass is compressed and discharged it is carried along together and no portion of it can be isolated and worked back and forth, as assumed, to have its temperature cumulatively augmented.

These attempts to solve the mysteries which still seem to be connected with some of the explosions that occur in connection with compressed air are certainly not to be discouraged. It would seem that the oil rather than the air is the thing to be studied. It is a noticeable thing that the initial explosions seem to occur more frequently in the pipes after the air has left the compressor rather than in the compressor cylinder head, where the temperature may be assumed to be the highest.

Compressed air alone, no matter how hot it may be, cannot possibly explode. The explosion is, of course, due to the ignition of a mixture of air and a volatile constituent of the lubricating oil. This volatile ingredient being present in sufficient quantity, there must still be provided time and opportunity for the mixing to be completed. This operation goes on rapidly, so that the conditions may be ripe for the catastrophe very close to the compressor. With the mixture ready for the explosion, ignition may occur spontaneously if the temperature is sufficient or a spark may be produced by friction and cause the explosion at a lower temperature.

Oil often burns bodily in the compressor cylinder heads and in the receiver without any explosion, receivers and contiguous piping sometimes becoming red hot. This might be going on in some case and provide the means of firing the explosive mixture which might be formed farther along in the pipes.

The obvious deduction is that we should use oils from which the more readily volatile constituents have been distilled, that we should use as little as possible of even the best oil and that, wherever there is a possibility of the used oil accumulating, provision should be made, and availed of, for frequent draining.

FRANK RICHARDS.

New York City.

CEMENT HELPS A CRACKED AIR CYLINDER

Editor Compressed Air.

In Compressed Air Magazine, Feb. 1909, page 5181, I notice "Concrete and a Broken Air Chamber." At Ryhope Collieries, where we are at present installing new compressors, in January of this year the old compressor developed a crack longitudinally in one of the air cylinders, the working pressure being 50 lbs. The water jacket was emptied and filled up with neat cement, a small spray of water being injected into the cylinder. In the meantime a new air cylinder was ordered, and the old one worked four weeks in this way until they were able to renew it. This I think is as good a temporary repair as the one quoted.

London, E. C. E. GRAHAM.

A BANNER YEAR EOR AMERICAN SHIP BUILDING

United States Shipping Commissioner, E. T. Chamberlain, reports that for the year ending June 30, 1908, the total number of vessels built in the United States was 1,457, with a gross tonnage of 614,216. For an approach to this record we have to go back to 1855 which had a total gross product of 583,450 gross tons. The total documented shipping of the United States at the date cited above was 25,425 vessels with a gross tonnage of 7,365,445 which is the largest in our history and larger than the tonnage under any other flag except the British, 11,563 vessels of 18,709,537 tons. Over one-third of our merchant tonnage is on the Great Lakes and the great bulk of the remainder is employed in domestic transportation.

AN OVERLOADING PARADOX

In an account, on another page, of the record cards of an automatically unloading air compressor, the compressor is said for a certain portion of the day to have been overloaded, as evidenced by the descent of the delivery pressure line at that time. What really was happening was that the air was being used or taken from the pipes faster than the compressor delivered it, so that the normal delivery pressure was not maintained. As the compressor was belt driven, and consequently operated at constant speed, the lowering of the delivery pressure involved also a lowering of the mean effective pressure for each stroke, and a corresponding reduction of the horse power consumed; and yet we are in doubt whether it was incorrect to say that the compressor was overloaded, and we are at a loss for a single word which would state the case more correctly. In the case of a horse, to take a part of the load from his back, would be a strange way to overload him.

NEW BOOKS

General Lectures on Electrical Engineering, by Charles Proteus Steinmetz, A. M., Ph. D., Robson & Adee, Schenectady. 284 pages, 6¼ x9¼ inches. Portrait of author in colors, numerous diagrams, no index. $2.00 net.

These seventeen lectures by Professor Steinmetz were originally delivered under the auspices of Union University in the winter of 1907-8 to a class of young engineers. They are so simple and intelligible, avoiding the use of mathematics entirely, that they are available to a large class of engineers who are engrossed in practical work. A broad review is given of the entire field of electric power generation, transmission, distribution, control and use, showing the close relation and interdependence of all the factors of the problem, and there seems to be not a waste word in the entire book.

TRADE PUBLICATIONS

Dubois Gas Engines and Producer Gas Plants, Dubois Iron Works, Dubois, Pa., 36 pages 6x9 inches. The engines built by this firm, also the gas producers, are here described and illustrated in detail with discussion of their practical operation. At the end are given practical costs of installing and operating both a steam and a producer gas plant of 200 h. p., with the result that while for the first year the steam plant would show a saving of $1,800 in first cost the gas plant would show for that year and for every year subsequent a saving in operating expense of $3,736.

Aids to Shippers, Oelrich & Co., Bowling Green Building, New York, 62 pages, 7x9 inches, stiff covers. This book is true to its title all through, containing various information principally for foreign shippers, with tables of money, weights and measures, shipping and custom regulations, classifications of goods, freight rates, etc. New and special information is given concerning automobile shipments. Sent postpaid on request.

Air Compressors for Industrial Service, Publication No. 386, National Brake and Electric Co., Milwaukee, 24 pages, 6x9 inches. The compressors shown are all electric driven, some combining compressor and pump, many of portable type.

Buffalo Blacksmith Tools, Catalogue 78B, Buffalo Forge Co., Buffalo, N. Y., 56 pages and cover, 6¾x10 inches. Forges of all kinds shown also blowers, punches, shears, drills, etc.

Westinghouse Fan Motors, 1909, Westinghouse Electric & Manufacturing Company, Pittsburg, 36 pages, 7x10 inches. Artistically illustrated and beautifully printed, embodying full information in the line indicated. The lightly clad nymph in colors on the cover, sitting by a pond with an electric fan playing upon her extremities carries rather beyond the limit for coolness.

A STEEL PROTECTING PASTE

A cement paste for protecting steel from gaseous fumes has been used by the Pennsylvania railroad at Columbus, Ohio, with signal success. The coating is a cement paste mixed in the proportion of 12 lb. pure red lead, 32 lb. portland cement, 4 lb. linseed oil, and 2 lb. dryer. This mixture should make a paste like putty, but if too soft, cement and red lead are to be added, and if too heavy, oil and dryer are are to be added. The method of application is as follows: 1. The iron or steel surface to be coated should be as clean of rust and foreign matter as it can be made, using either sand-blast, steel brush, chisel, or sand-paper for this purpose, according to the amount and hardness of the foreign matter to be removed. 2. Apply one heavy coat of red lead and allow it to set. 3. Apply one heavy coat of Japan dryer. 4.

Apply paste on dryer while latter is green; do not allow Japan dryer to become dry before applying paste. The paste should be put on about one-eighth inch thick, rubbed with trowel and pressed around rivet heads and angle flanges by hand. 5. Cover all with one coat of red lead. This last coat adds a great deal to the life of the coating, as it retards the hardening effect of the atmosphere on the paste. The life of the coating is said to be six years, and the cost for labor and material, including the cleaning of the metal, eight cents per square foot.

DEMIJOHN WATERS

A "Spring Water" shipment was seized in Washington a few days ago by order of the Bureau of Chemistry of the Department of Agriculture, on the ground that it contained the colon bacillus. The Bureau of Chemistry is beginning an investigation of the bottled waters and soda fountain supplies in the District of Columbia, that is likely to furnish interesting results. The seizure recalls an investigation made a good many years ago by John W. Hill, of Cincinnati, which showed a very large number of bacteria in one of the favorite imported spring waters. It would be interesting to know how many analysts have made a similar discovery, for it is currently believed that a good many of these so-called spring waters so common in office buildings are really worse than the regular city supplies, although they may have less color. Some years ago the Massachusetts State Board of Health investigated a number of the springs of that commonwealth whence water was bottled, and its report is well worth consulting by those who are inclined to put their faith blindly in the alleged high quality of every kind of water that is peddled in a green demijohn.—*Engineering Record.*

GAS ENGINE DRIVEN GAS COMPRESSORS

The Mohican Oil & Gas Co., one of the large gas operators in the central Ohio district, is establishing a compressing station at Howard, Ohio. The initial equipment of this station will comprise two 1,000 H. P. direct acting two-stage compressors driven by Westinghouse horizontal, double-acting, twin-tandem gas engines. These machines will be of the same design as the standard gas engine which has been so successfully applied to power station work. These units are designed to operate on the varying suctions occurring at the wells from time to time, and to deliver at any desired pressure up to 300 lbs. They will, of course, operate on natural gas, using for this purpose a small percentage of the gas pumped for distribution.

THE RAILROAD SIDE OF IT

The Missouri River is in a better navigable condition to-day than it was when boats plied its entire navigable length of 2,285 miles; but no boats run there to-day for the simple reason that they cannot live and carry freight. This and similar reasons apply to the Mississippi and Ohio and their tributaries. The railroad comes to the people's doors; it carries them and their produce in the direction they want to go; it carries them 400 miles a day as against 50 to 100 by the river; it operates in winter as well as in summer; in the fall of the year when crops are harvested and freight is most abundant and transportation most needed, the railroad is in the best physical condition of the entire year while the rivers (through low water) are in the poorest; and finally the railroad carries so cheaply that the profit is taken out of the river business. The railroad satisfies the needs of the people better than do the rivers and it gets the business. In Europe railroads do not serve the people as well or as cheaply, while far greater attention is given to the development of waterways than here, and this fact and the greater density of population, are the true reasons why the inland waterways of Europe are used more than they are in this country.

NOTES

To find the contents of a cylindrical tank in gallons, multiply the square of the diameter in feet by half the length in inches. The result will be about 3 per cent. too low.

There is no finality in engineering; the solution of any one problem is the propounding of several new ones, and each is but another step in the unending march of progress.

There is a water power plant being erected in Norway with an installed capacity of about 400,000 kilowatts (536,000 h. p.) to be used solely for making nitrates from atmospheric introgen.

The average cost for supplying 1,000,000 gallons of water, based on the reports of twenty-two cities, was $92, this sum including operating expenses and interest on bonds.

It is understood that the shops of the western divisions of the Canadian Pacific Railway are to be located at Lethbridge, Atberta, on account of the supply of natural gas available for fuel. The shops will employ about 600 men to begin with.

More than a million official communications are handled annually by messengers between the collector's office and the appraiser's office in New York, and the Secretary of the Treasury has very properly asked Congress for an appropriation for a pneumatic tube system connecting the two offices.

To escape the payment of $35,000 bonds and $1,000 interest, Ulysses, the capitol of Grant County, Kansas, has been relocated a mile and a half outside its own city limits. Only a frame court house and a school building mark the spot where 20 years ago stood a prosperous village of 1,200 inhabitants.

The following is one "claim" of a patent recently issued to T. A. Edison:

1. The process of making very thin metallic flakes, which consists in subjecting metallic granules to successive rolling operations, and annealling the same in a gas which does not react thereupon, *between one* or more of the passes, substantially as set forth.

A decision of the Supreme Court of Oregon makes it impossible for any person or corporation to hold a water power or irrigation right for speculative purposes. Those persons, therefore, who have filed claims on water powers on any of the rivers must put the water to a beneficial use or forfeit the right to the first person who does so apply it.

The flat-wheel evil is known to everyone who rides in cars, but few realize the enormous energy developed by a flat spot in a car wheel. Professor Hancock, of Purdue University, finds that a flat spot 2½ inches long on a 33-inch wheel, carrying a load of 6,000 pounds at 30 miles per hour, will deliver a blow to the rail of more than a 1000 foot-pounds. The same flat wheel supporting a 55-ton interurban car running at 60 miles per hour, would deliver a blow with an energy of 9,500 foot-pounds. Such a flat spot would be produced by wearing off less than 0.05 inch of metal.

The destruction of water pipes by electrolysis at Winnipeg, Manitoba, is stirring the thoughts of engineers, property owners, city officers and street railway managers. The trouble has recently become more pronounced and heavy damage suits are threatened. In certain parts of the city it has been necessary to replace pipes as often as once a year.

It is estimated that in the Borough of Manhattan there are about 10,000 passenger elevators and 12,000 elevators for freight service. In twenty-six office buildings of eighteen stories and over, with a rentable area of 116 acres, there are 231 elevators, which travel between 4,000 and 5,000 miles of vertical distance each day, and carry 615,000 passengers. There are 8,000 elevators in office buildings alone.

The gangplank of the "Kaiserin Auguste Victoria," of the Hamburg-American line, slipped from its place during the discharge of cargo at Hamburg, Germany, Feb. 24. Thirty persons were dropped into the water and 14 of them were drowned. The work of rescue was hampered by ice in the water near the dock. Reports state that those killed were stewards and stewardesses of the ship and dock laborers.

Oxygen has become the almost universal remedy in cases of poisoning by gases—such as coal gas, acetylene, foul air from sewers, after-damp of mines, etc.—but its application is a difficult matter for the inexperienced bystander. A new apparatus by Dr. Brat made in Westphalia, is designed to clear the lungs and act more or less automatically in giving artificial respiration. The portable form consists of a fair-sized oxygen cylinder, a chest containing a small air pump, levers and other parts, and the usual face mask for the patient. When able to do so, the patient breathes the oxygen without help. If necessary, the attendant gives a rhythmical motion to the pump valve, and the liberated oxygen actuates the pump, withdrawing air from the lungs. Respiration is thus re-started or supported.

The grouting of cracks in foundations and walls should be done under pressure. This is accomplished by discharging the contents of a receiver filled with grout (which is a mixture of cement, fine sand, and water, of the consistence of cream) under air pressure. For this purpose an air pressure of from 80 to 100 lbs. per square inch should be used. The edge of the crack should be pointed up, and allowed to set before filling with grout.

The municipality of Plauen, Germany, following the example of Paris, has adopted a new regulation forbidding the use of natural ice in drinks, like beer or other beverages, because of the danger from impurities in such ice which might be inimical to health. In the cafes, hotels and public drinking places of the German town, however, only manufactured ice is permitted to be used in drinks, under penalty of 150 marks or imprisonment for not to exceed fourteen days.

In a discussion at the A. S. M. E. semi-annual meeting it was stated that strips of seven materials, mounted on a board and subjected to the uniform action of a sand blast for 45 minutes show the following relative abrasive-resisting qualities, rubber belting being taken as the standard: Rubber belt, 1; rolled-steel bar, 0.66; cast iron, 0.28; balata belt, including gum cover, 0.2; woven cotton belt, high grade, 0.16; stitched duck, high grade, 0.13; woven cotton belt, low grade, 0.06 to 0.11.

Cylinder oil in air compressors undergoes partial combustion to carbon monoxide, owing to the high temperature produced in the cylinder, which ranges from 350 to 450 degrees F. This gas, if produced in large quantities, so as to become mixed in the proportion of about 1 part of carbon monoxide to 2½ parts of air, is highly explosive. The gas is also poisonous, and the atmosphere in narrow working-places where air-drills are used, is sometimes rendered injurious from this cause. The remedy is to use a high-grade cylinder oil which is non-volatile and resistant to combustion at the temperature of the compressor cylinder.

The H. W. Johns-Manville Company, of New York, is introducing a chemical compound, called Leak-No, which resembles powdered iron, and when mixed with water and applied like putty to cracks, or other defects, in iron or steel articles, metallizes and becomes a permanent part of the article to which it is applied. When hard it much resembles iron in color. The manufacturers offer to refund the purchase price in case it fails to stop any ordinary leak in anything made of iron or steel against any pressure of oil, steam, gas, air, ammonia or water; and to stand any heat or chemicals that iron will stand, when applied according to directions.

Natural gas, being composed almost entirely of methane, or marsh gas, requires much more air than artificial gas to effect its complete combustion. Methane requires twice its volume of oxygen, while hydrogen and carbon monoxyde, the chief constituents of artificial gas, require only one-half their volume, so that roughly, about four times as much air is necessary for the complete combustion of natural gas as is required for artificial gas. The orifices of appliances for burning natural gas are smaller than those for artificial gas on account of the high pressure at which the former is carried.

In Europe a new composition, "Unica," the principal constituent of which is compressed cotton, is coming into use for silent gear power transmission. Tests carried out at the Royal Testing Institute in Berlin show that their resistence to indentation is 45 per cent. greater than that of German rawhide at 1,120 pounds pressure per square inch, and that they offer 100 per cent. greater resistance to displacement than rawhide at maximum pressure. Other advantages of the gears are stated to be that they are not affected by oil, and are cheaper than other types of silent gears. They can be key-seated the same as ordinary metal gears without fear of failure, and without the necessity of using bushings.

An English firm of egg importers, according to a report by U. S. Consul, Joseph G. Stephens of Plymouth, England, has inaugurated a new system of preserving eggs. Acting on the theory he says, that an egg decomposes owing to the entrance of bacteria through the shell, the eggs by the new process of preservation are first disinfected and then immersed in a vessel of hot paraffin wax in a vacuum. The air in the shell is extracted by the vacuum, and atmo-

spheric pressure is then allowed to enter the vessel, when the hot wax is pressed into the pores of the shell, which thus hermetically seals it. Evaporation of the contents of the egg, which has a harmful effect, is thereby prevented, and the egg is practically sterile. The yolk of pickled eggs and others artificially preserved will frequently break on being poached, but the eggs preserved by this novel process are quite free from such fault.

Tunnel linings in rock far below the surface are often considered exposed to extremely heavy pressures, which do not come into play immediately on excavation. According to Dr. Karl Brandau, such evidences of general pressure were never experienced during the construction of the Simplon tunnel. Where the superincumbent mass was greatest, the lightest type of masonry lining was almost universally employed, and has never shown the least sign of damage. Wherever merely local and unimportant pressures were observed, they were invariably due to decomposed rock of small internal cohesion. He therefore believed that no considerable difficulties arise from the pressure of the superinposed rock in the construction of a tunnel, even at depths of more than 6,800 ft, in good compact stone, though great difficulties are experienced in plastic material of considerable thickness.

Rapid moving of a 12-in. high-pressure wrought-iron gas main, forming an important supply line to a 5,000,000-cu. ft. gasometer and high-pressure district, was recently accomplished at Santa Cruz, Cal. Owing to the construction of a storm sewer by the city, it was necessary to lower 300 ft. of the main about 3 ft., and also to move a 60-gal. flanged cast-iron drip pot in it, weighing 2,000 lb., some 150 ft. After excavating and bracing the ditch, which was in sandy soil, the main being supported on chain blocks and slings, the drip pot was first removed from the line and then the main lowered and the 150-ft. section between the old and new locations of the drip pot moved along to accommodate the latter. Next, by flange couplings, the pot was connected in at the new location and the ends at the former opening closed by a special sleeve coupling. This work was accomplished by seven workmen, and the main was out of service but 2 hours and 45 minutes from the time gas was turned off until turned on again.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

FEBRUARY 2.

911,041. PNEUMATIC TIRE. EDGAR J. HICKS, Indianapolis, Ind.

911,056. AIR-GUN. WILLIAM F. MARKHAM and ERNEST S. ROE, Plymouth, Mich.

911,161. AUTOMATIC COMPRESSED-AIR TRAIN SIGNAL AND STOPPING SYSTEM. ROBERT B. ROBINSON, Kansas City, Mo.

911,180. ROCK-DRILL LUBRICATION. JAMES A. THOMPSON and EDWIN M. MACKIE, Chicago, Ill.

911,249. AUTOMATIC PRESSURE-REGULATOR. PRIMO LULLI, Uccle, near Brussels, Belgium.

911,294. STORAGE APPARATUS FOR LIQUEFIED GAS. MILTON CHASE, Haverhill, Mass.

911,389. RESPIRATION APPARATUS FOR USE IN COAL-MINES AND OTHER PLACES. WILLIAM E. GARFORTH, Normanton, England.

911,431. SAND-BLAST APPARATUS. DAVID A. NICHOLAS, New York, N. Y.

911,505. PRESSURE-REGULATOR. ARTHUR KLEINFELDT, Hoboken, N. J.

FEBRUARY 9.

911,610. MECHANICAL MERCURY-SEALED VACUUM-PUMP. MAX VON RECKLINGHAUSEN, New York, N. Y.

911,649. EQUALIZING MULTIPLE AIR-LIFT FOR DEEP-WELL PUMPING. ROBERT H. ELSEY, Coalinga, Cal.

911,726. BOTTOM-DOOR HOIST FOR FURNACES OR CUPOLAS. JAMES HYSLOP, Harvey, Ill.

911,752. WINDMILL. EDWARD T. PARKER, Vermilion parish, La.

911,802. APPARATUS FOR SEPARATING HEAVY PARTICLES FROM AIR AND OTHER GASES. WILLIAM J. BALDWIN, New York, N. Y.

911,875. APPARATUS FOR MEASURING THE HUMIDITY IN OR DETERMINING THE EVAPORATING POWER OF THE AIR. MILO M. HASTINGS, Washington, D. C.

911,953. AIR-BRAKE APPARATUS. JAMES O. DODGE, Los Angeles, Cal.

912,124. FLUID - PRESSURE INDEXING MECHANISM. BENGT M. W. HANSON, Hartford, Conn.

912,158. AIR-SHIP. FRANCIS L. ORR, Omaha, Neb.

912,207. PNEUMATIC-ACTION CONSTRUCTION. CLYDE H. THOMPSON, Meriden, Conn.

912,234. PNEUMATIC HAMMER. ALFRED J. DOUGHTY, Detroit, Mich.

912,243. VACUUM-BREAKER AND ALARM. BURTON W. HILL, Somerville, Mass.

912,261. SPRAYER. CHARLES S. PERRY, Chattanooga, Tenn.

912,269. AIR-BRAKE SYSTEM. GEORGE MACLOSKIE, Jr., Schenectady, N. Y.

FEBRUARY 16.

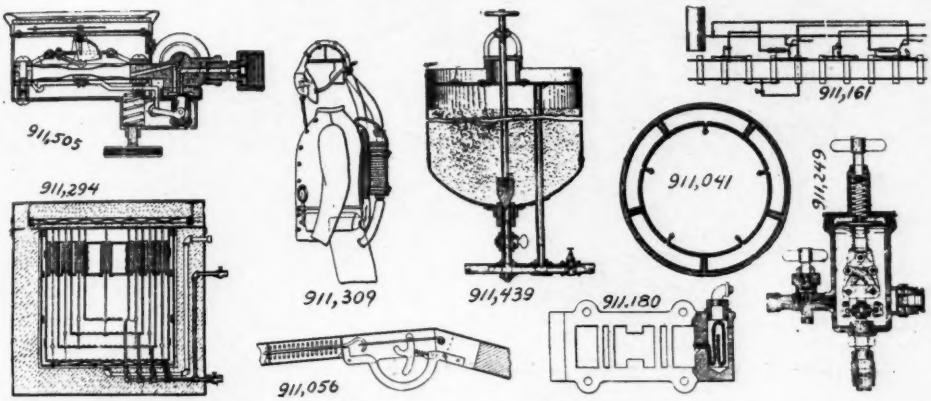
912,317. AIR-BRAKE APPARATUS. HOWARD M. P. MURPHY, Pittsburg, Pa.

912,366. PNEUMATIC SELF-PLAYING MUSICAL INSTRUMENT. LEWIS B. DOMAN, Elbridge, N. Y.

912,376. PNEUMATIC SPRING. WILLIAM H. HUMPHREYS, Liverpool, England.

912,502. FLUID - PRESSURE - CUSHIONING DEVICE. CHARLES E. SQUIRES, Cleveland, Ohio.

912,549. ROTARY BLOWER. LEWIS E. FAGAN, Minneapolis, Minn.



PNEUMATIC PATENTS, FEBRUARY 2.

912,641. METHOD OF EFFECTING THE PRECIPITATION OF FLUE-DUST IN BLAST-FURNACES AND OF PREVENTING THE FORMATION OF THE SAME. RALPH W. H. ATCHERSON and WILLIAM SIDDALL, Bellaire, Ohio.

The method of precipitating dust or solid matter from the furnace gas of blast furnaces and the like, which consists in directing throughout the whole of the gas zone of the furnace jets of a dust-dampening agent under high pressure for dampening the fuel-bed and for overcoming the momentum of such dust-particles as are carried in suspension by said gas.

912,647. MEANS FOR EXPANDING COMPRESSED AIR. ROBERT S. CATES, Kingman, Kans.

912,655. PNEUMATIC-TOOL HANDLE. WILLIAM O. DUNTLEY, Chicago, Ill.

912,706. AIR-VALVE CAGE FOR AIR-BRAKE PUMPS. JAMES MATTINGLY, Marshall, Tex.

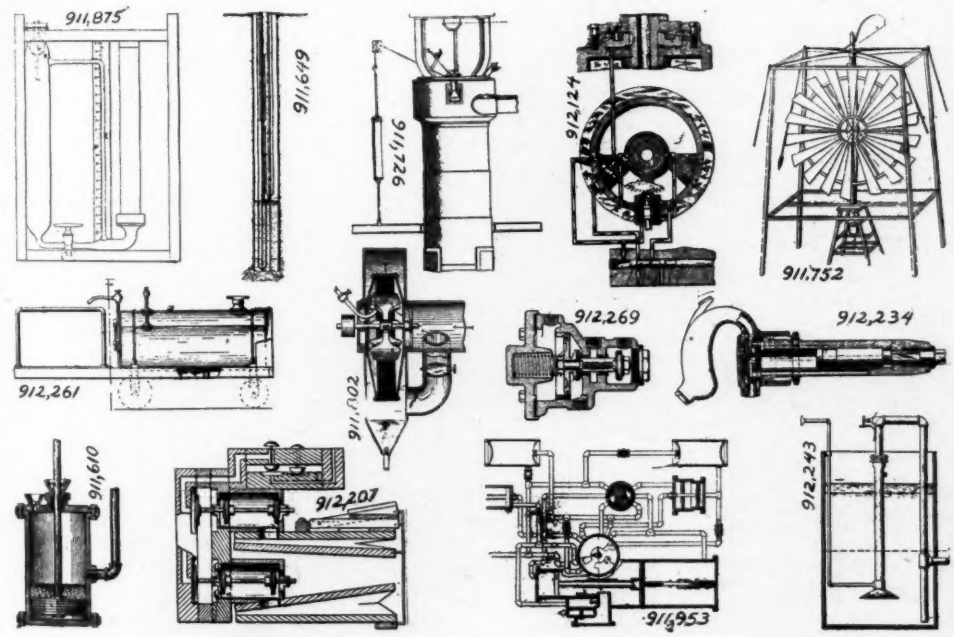
912,712-713-714-715-716-717. AIR-BRAKE APPARATUS. HOWARD M. P. MURPHY, Pittsburg, Pa.

912,725. PNEUMATIC TIRE. GEORGE J. PAYNTER, Philadelphia, Pa.

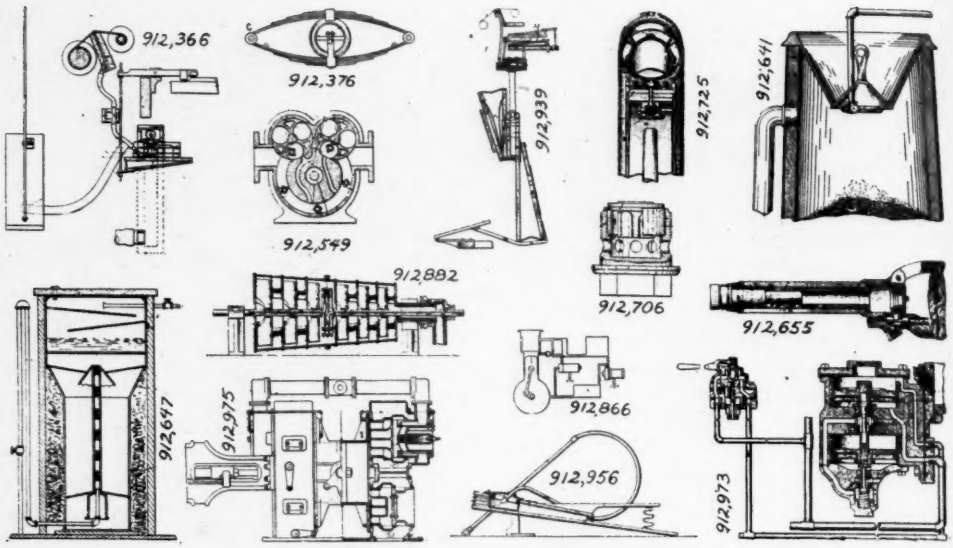
912,866. SYSTEM OF REFRIGERATION. ROBERT F. MASSA, Chicago, Ill.

912,882. AIR-COMPRESSOR. OLE P. ORAKER, U. S. Navy.

912,939-940. PNEUMATIC SELF-PLAYING MUSICAL INSTRUMENT. LEWIS B. DOMAN, Elbridge, N. Y.



PNEUMATIC PATENTS, FEBRUARY 9.



PNEUMATIC PATENTS, FEBRUARY 16.

912,956. PNEUMATIC DUSTING AND SWEEPING APPLIANCE. CHARLES J. HARVEY, Kidderminster, England.

912,973. AIR-BRAKE APPARATUS. HOWARD M. P. MURPHY, Pittsburg, Pa.

912,975. AIR AND GAS COMPRESSOR. FRED E. NORTON, Youngstown, Ohio.

FEBRUARY 23.

913,010. MERCURY VACUUM-GAGE. AUGUST B. HOHMANN, Richmond Hill, N. Y.

913,058. ENVELOP OF AIR-PROOF MATERIAL. ADDISON T. SAUNDERS, Akron, Ohio.

1. A pneumatic article of manufacture comprising an envelop containing compressed air, composed of a pliable gelatinous compound non-liquifiable by but adhesive under heat, substantially as described.

913,260. DEVICE FOR DELIVERING GASEOUS FLUID UNDER PRESSURE. CHARLES A. CLAFLIN, Medford, Mass.

913,321. GAS-PRESSURE GAGE. WALTER THOMAS, Vancouver, British Columbia, Canada.

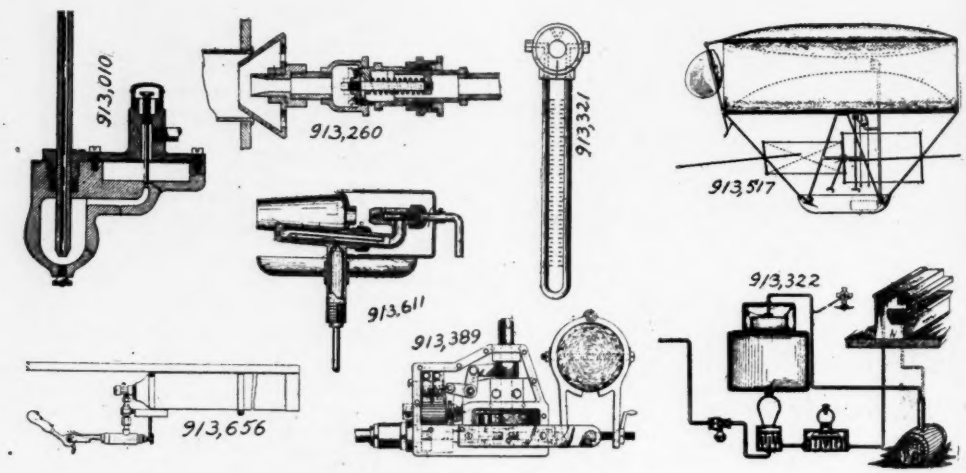
913,322. BLAST APPARATUS. EVERETT L. THOMPSON, Dover, N. J.

913,389. ROCK-DRILL. LEONA H. JENKINS, Philadelphia, Pa.

913,517. AERIAL VESSEL. CHRISTOPHER JOHN LAKE, (name changed from John Christopher Lake by judicial order), Bridgeport, Conn., and SPENCER HEATH, Washington, D. C.

913,611. BURNER FOR BLOW-TORCHES. EMIL BEYER, Newark, N. J.

913,656. APPARATUS FOR CHARGING CAPSULES WITH LIQUEFIED GAS. PIERRE GIRON, Paris, France.



PNEUMATICS PATENTS, FEBRUARY 23.